ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXVIII. No. 47.

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The gross earnings of railways in the United States for the month of October show only a very moderate gain over figures for the corresponding month of 1891, notwithstanding the unusually heavy grain movement. According to the "Financial Chronicle" they were for 132 railways operating 91,795 miles of line, $51,685,333, compared with $50,747,665 for October, 1891, an increase of 1.85%. This small increase is due to the fact that, with the exception of the heavy grain shipment, nearly all influences were adverse to heavy earnings. There was a very small cotton movement, accompanied by wet weather in the South and Southwest, and an unusually severe blockade of cars on the grain carrying lines, besides several holidays and an extra Sunday during the month, and quite important strikes of trainmen on one or two roads. As a rule, the roads having a heavy grain traffic show gains, while those engaged in the transportation of cotton, or which have suffered for some other reason, fall behind last year's figures. Considered by groups, the detailed figures show generally poor results, with a few notable exceptions, from the Southern and Southwestern lines. Many of the Northwestern lines also fall behind. The trunk lines and Middle and Middle Western roads present quite satisfactory results from operations, and a moderate improvement is exhibited by the Pacific railways. Increases of over $30,000 are shown by 24 roads and decreases of the same amount by 15 roads.

The New York City Rapid Transit Commission has issued the specifications and terms of sale of the franchise for the proposed rapid transit railway; the adopted designs for which were published a year ago, (Eng. News, Oct. 24, 1891). The franchise is to be sold to the highest bidder at the New York City Hall on Dec. 29. The terms of sale require 10% of the amount bid for the franchise to be paid in cash, and the remainder within 30 days. The successful bidder must deposit $1,000,000 cash with the City Controller and file a $2,000,000-bond with the Mayor as security for the faithful performance of his contract. The successful bidders may form a company to build and operate the road, the capital stock of which shall be $50,000,000 and it may issue bonds to an equal amount. In our next issue we shall give a full abstract of the specifications and detailed plans prepared by the Commission's engineers.

An entirely novel method of raising the money necessary for the construction of the proposed Guatemala Northern Railway, is to be attempted by the Guatemalan Government, according to the London "Times." The cost of the railway is estimated at about $10,000,000, and to obtain this amount the government will issue two classes of capital stock. The first class is to be taken by voluntary subscribers, who will pay for the stock on the instalment plan. The stock of the second class will be "imperatively allotted": (1), to all civil and military employees of the government whose salaries exceed $150 per month, 10% of such salaries being retained monthly by the authorities to pay for the stock "allotted" to the employees of this generous government; (2), to every municipality of the Republic, which will pay for it out of the octroi duties, 5% of which will be devoted to this purpose. Interest at the rate of 7% per annum is guaranteed on both classes of shares, but the second class will not be entitled to any interest for the five years during which the several instalments of the capital will accrue. To pay this interest certain portions of the customs duties are pledged.

The most serious railway accident of the week was a rear collision Nov. 9, at Highland Center, In., on the Chicago, Milwaukee & St. Paul Ry. A local freight train, which was behind time, was standing on the track, and was run into by a fast freight train, the caboose and four cars being wrecked. The wreck caught fire, and four persons imprisoned in the wreck of the caboose were burned to death. Three persons were badly injured.

A locomotive boiler exploded at Conner's Crossing, near Schuylkill Haven, Pa., on the Philadelphia & Reading R. R., Nov. 14. The engine was a mogul freight engine with Wootten firebox, and was hauling a train of empty cars. Several men were riding in the cab. Five men were killed and one injured. According to press dispatches, the boiler was blown off the frame. Low water is said to have been the cause of the accident.

A trestle at the mines at Honey Brook, Pa., gave way Nov. 7 under a load of ten mine cars, throwing the cars and 6 men to the ground, 40 or 50 ft. below. One man was killed and six were seriously injured.

An explosion of dynamite occurred near the main wheelpit of the Niagara Falls water power tunnel on Nov. 12. The magazine contained about 166 lbs. of explosive, which exploded, wrecking the shops and buildings. One man was killed and several were more or less injured.

A timber flume, 52 miles long, has recently been constructed in Fresno Co., Cal., for carrying timber from the Sierra Nevada Mts. to the plain below. The flume is V-shaped on an angle of 90°, 3 ft. 7 ins. across the top and 21 ins. deep vertically. At the lower terminus these dimensions increase to 3 ft. 7 ins. and 31 ins. The sides are built of 1¼-in. boards, and the flume is carried on trestle work in some places 130 ft. high. The steepest grade is 1,200 ft. in 5,280 ft., or one mile, for about 3,000 ft. in length, the total fall in that length being 730 ft. The King's River is crossed by a suspension bridge with a stiffening truss, put in by the engineer, Mr. J. M. Graham, to provide for the series of violent undulations which result from the use of the flume. About 9,000,000 ft. B. M. of lumber was used in the construction.

A novel method of street grading is proposed to meet a special case in Seattle, Wash. One side of the street is much higher than the other, and to avoid heavy damages to abutting owners, City Engineer Thomson recommends as follows: The street is 80 ft. wide, and a roadway 26½ ft. wide is proposed for each side, leaving a terrace 27 ft. wide and 18 ft. maximum height in the center. The grades of the two side streets gradually meet and an intersecting street is cut off from the lower way, but is turned into the upper road. We hope to present a detailed plan shortly of the method used.

Philadelphia, Pa., proposes to spend in 1893 nearly $2,000,000 for sewers. The estimates handed in by the department of public works include $1,000,000 for main sewers, $250,000 for the Aramingo Canal sewerage system, $350,000 for branch sewers and $110,000 for intercepting sewers. The estimates also call for $150,000 for a new bridge over the Schuylkill and $500,000 for subways on Market St. from the Delaware River to the City Hall. All of these items are formally indorsed by the Survey Committee of Councils.

The U. S. protected cruiser "Cincinnati" was launched at the Brooklyn Navy Yard on Nov. 10. Her dimensions are: Length on load water line, 300 ft.; beam, 42 ft.; draft in cruising trim, 18 ft.; displacement with 604 tons of nickel-steel armor, 3,183 tons. The hull is double, divided into numerous watertight compartments by transverse and longitudinal bulkheads, and the space between the hulls is filled with "woodite." The vessel will be rigged as a two-masted schooner, spreading 7,210 sq. ft. of sail. She will be propelled by two sets of triple expansion engines, with 57, 53 and 36-in. cylinders, and 33-in. stroke, with steam at 160 lbs. pressure. The battery will be made up of ten 5-in. rapid-fire guns, one 6-in. breech loading rifle; eight 6-pdr. and one 1-pdr. rapid-fire guns, two gatling guns and six torpedo launching tubes. The cost of the "Cincinnati" was about $1,000,000, and she was built by the Government.

The Baker submarine boat is at Chicago for purposes of further experiment in deep water. This boat was built by Mr. George Baker at Detroit at a cost of about $30,000. It is somewhat cigar-shaped in form and is 40 ft. long and 14 ft. deep. The hull is built of oak 6 ins. thick and is able to withstand a pressure of 75 lbs. to the sq. in. Under water the boat is propelled by electricity, and steam generated from burning oil is used for surface travel. The inventor claims a "good speed" under 16 ft. of water and is about to try it at greater depths.

The number of fixtures of different kinds connected with the sewers of Los Angeles, Cal., on Nov. 30, 1891, is given in detail in the last annual report of City Engineer J. H. Dockweiler, as follows:

Water closets.....	5,072	Horse troughs.....	40
Sinks.....	3,115	Fountains.....	32
Basins.....	2,372	Chinese laundries..	32
Baths.....	1,552	Washing machines..	25
Urinals.....	960	Shower baths.....	11
Sloppers.....	590	Livery stables.....	7
Laundry tubs.....	546	Bathing tubs.....	4
Roof connections...	287	Elevators.....	2
Carriage racks.....	84	Dye tubs.....	3
Drains.....	52		
		Total.....	14,008

The number of miles of sewers on the same date was 45.91. A part of this length of sewers is probably intercepting sewers. The population, according to the census of 1890, was 50,395, against 11,183 at the time of the census of 1880. For some years Mr. Dockweiler informs us, the sewage was used for irrigation by the South Side Irrigation Co. An outlet sewer some 12 miles long is to be built to the Pacific Ocean. Provision will be made for carrying this sewage onto land for irrigation along the course of the outfall. Bonds to the amount of $395,000 have been voted to meet the cost of constructing the sewer, which will have two inverted siphons three miles in length, built of wood staves.

The Chicago Drainage Board has adopted the Illinois & Michigan canal as the route of its main drainage channel between Ashland Ave. and Summit, a distance of 8 miles. The decision between six different routes, of which the canal was one, has been in the hands of the joint committee on engineering and finance since June 7, when Mr. Benezette Williams, Chief Engineer, presented a report on the subject, with plans and maps in detail, and recommended the canal route as the most advantageous from an engineering standpoint.

The temporary Massachusetts State Highway Commission is making a final report to the legislature. It is expected that this report will recommend a permanent state commission. Two plans are under consideration for carrying out a system of improved roads. One is the issue of a state loan for $5,000,000 for the construction of about 12,000 miles of new road in the most traveled parts of the state. The other plan is to add to the state tax an amount equal to 4% interest on $7,000,000, and to use this interest for the more gradual improvement of roads. An interesting feature of the report will be the statistics of load-weights, width of tires and amount of travel over five roads near Boston for three days. A bill is now being drafted to squarely present the road issue, and this will be submitted with the report.

A new twin-screw Sound steamer is to be designed by Mr. A. Cary Smith for the New York & New England Railroad Co. Mr. Smith designed the yacht "Priscilla" and the "Richard Peck," the latter being now the fastest boat on Long Island Sound.

A Nicaraguan Canal convention is to be held in New Orleans, commencing Nov. 30. This is the conference called for at the last meeting held in St. Louis. Col. T. T. Wright, of Nashville, Tenn., is now in New Orleans preparing the way.

Another Government rain-making expedition is at San Antonio, Tex., preparing for further experiments with 40 tons of improved explosives. Kansas and Texas capitalists have contributed $10,000 to the enterprise and the Government has appropriated $5,000 more.

A steel chimney has been built in Chicago, according to an exchange. It is 350 ft. high, with an outside diameter of 9 ft. 5 ins. The steel varies in thickness from 5-32 in. at the top to ⅝ in. at the bottom. The lower 75 ft. is lined with 8 ins. of firebrick, and above this the lining is hollow tile, supported at intervals of 25 ft. by angle-iron riveted to the steel shell. The foundation is made of steel rails and I-beams, laid in cement.

TELEGRAPH LINES AND RAILWAYS IN CHINA.

By Romyn Hitchcock.

There is a perfect network of railways in Japan, but only a single line 100 miles long in China. Such is the difference between the two countries, exemplified also in many other ways. Nevertheless, if we were to rely upon this bare statement of the case as indicative of the intellectual condition of the two nations, we might arrive at conclusions very wide of the truth.

The Chinese are a very conservative people. They object to innovations because it is in their nature to do so, and all the more strongly if they discover any disposition on the part of foreigners to force innovations upon the country. Nevertheless, they are a very intelligent and reasonable people. When they are convinced that any undertaking will benefit them they are ready to favor it. The strongest opposition to railways has not come from the common people of China, but from the educated classes and officials. The officials oppose them on selfish and personal grounds, fearing to lose their gains from "squeezes" or local taxes upon goods in transit. The scholars recognize that the spread of foreign ideas and methods of study will lower their own prestige; for they are wise enough to see that the teaching and practices of the foreigners are gaining a foothold in the land.

Formerly we heard a great deal about the superstitions of the Chinese, which were supposed to be inimical to everything foreign. There is in truth a strange mixture of superstition and sound sense in the Chinese character. "Fung shui" is still a powerful influence in the land. The people were very much disturbed by the first telegraph poles; but inasmuch as the government wanted the telegraph, the popular opposition to it was overcome—sometimes, it is true, only after a struggle—and there are now 17,000 miles of wire crossing the country from its most remote boundaries. Over $6,000,000 has been expended on these lines.

But it was no small matter to reconcile the people to the poles, which the geomancers declared would disturb the powers of the air and bring calamity upon the country. In Hunan, for example, 10,000 persons came together and burned over 2,000 poles as an intimation of the feeling in that province. The government discreetly abandoned the enterprise there and Hunan is one of the two or three provinces which are still without telegraphic communication. Hunan is the strongest anti-foreign province of China, and was the original source of much of the trouble which was experienced by foreigners in the interior last year. Whether the opposition to the telegraph in Hunan was inspired by superstitious fear of the consequences, or by the ruling gentry, who hate foreign innovations of any kind, is perhaps uncertain.

The wonderful development of the telegraphic service shows, however, that the officials are quite able to carry out an enterprise in spite of popular superstitions; and in the case of railways, they even go so far as to remove family graves, which is doubtless the most serious cause of offense to popular prejudices imaginable.

At Tientsin there is a telegraph school where operators are trained and educated. Chinese characters, of which there are about 10,000 in use for business purposes, are transmitted by numbers according to the Morse system. But a far better system is that of Mr. C. Paulsen, who has prepared a code in which each character is represented by an English word, and it is this system which will doubtless be adopted in future.

The operators are divided into several classes, the lowest grade receiving 10 taels a month, and the others 14, 24, and 45 taels respectively. A tael being worth about $1.27 gold, the pay is liberal enough.

As a whole the telegraph system is profitable. The government owns some lines which are not paying expenses; but those which are doing the best and most profitable business have become private lines, in accordance with the policy of the government.

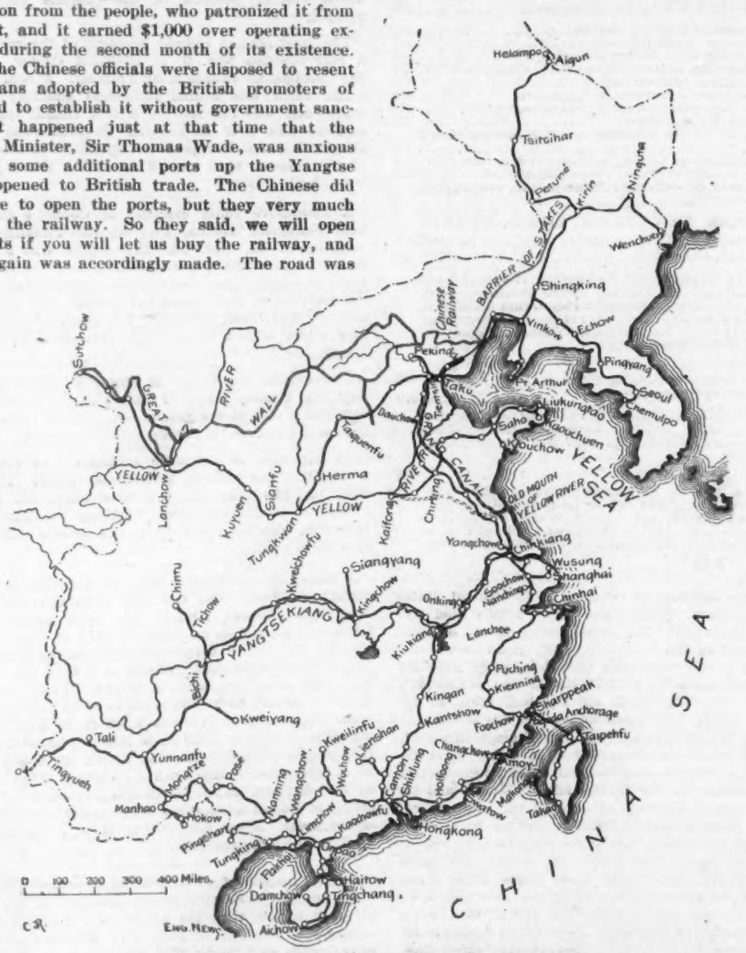
In addition to the lines shown on the map, a line was opened in 1891 through Kansu and Shensi, and the Yunnan line was joined to the French system of Tung King.

The first railway in China was opened in 1876. This was the Shanghai-Woosung road, about 10 miles in length. It continued to run for about a year, when it passed out of existence. The old roadbed can be seen about Shanghai still, doubtless because the Chinese could not very well carry it away, as they did everything else. The circumstances were peculiar. The foreigners in China thought that if they could get a railway in actual operation the Chinese would be quick to recognize its advantages and that opposition to further extension of such lines would cease. So they secured the right of way ostensibly for a carriage road, and had it all graded and the rails actually laid before the Chinese realized what was going on. It was a purely experimental road, with a gage of 2½ ft. and an engine of nine tons, only adapted for passenger traffic. It encountered no opposition from the people, who patronized it from the first, and it earned $1,000 over operating expenses during the second month of its existence.

But the Chinese officials were disposed to resent the means adopted by the British promoters of the road to establish it without government sanction. It happened just at that time that the British Minister, Sir Thomas Wade, was anxious to get some additional ports up the Yangtse River opened to British trade. The Chinese did not care to open the ports, but they very much wanted the railway. So they said, we will open the ports if you will let us buy the railway, and the bargain was accordingly made. The road was purchased by the Chinese government for 285,000 taels, and the transfer was made in October, 1877. It was then doing a profitable business. But immediately it was torn up, the engine and cars were taken to pieces and the whole plant sent off to Formosa to get it out of the way. Thus did the Chinese resent the imposition played upon them by the foreigners, at a cost of considerably over a quarter of a million dollars. In a similar manner did they also resent the attempt of the British to introduce opium in defiance of the laws of the country, when the Commissioner Lin, at Canton, destroyed $15,000,000 worth of that drug.

The destruction of the railway was not caused by popular opposition to it, for ten years later another road was opened by the China Railway Co., a purely Chinese organization. This is now the only line in operation in China, but more than 1,000 miles of railway are projected and have received imperial sanction. The Tientsin, Tongku & Kaiping line, opened in 1888, is a part of a much longer system, which is being pressed to completion as rapidly as the available funds will permit. The Kaiping coal mines are about 90 miles from Tientsin and this part of the road, constructed at a cost of 1,500,000 taels, has been operated for several years at a profit of 5 to 6%. In December, 1890, the line was opened to traffic between Kaiping and Linsi, and the extension has since been carried to the Lan River, over which a temporary bridge was erected, but this was swept away by a recent rise of the river.

The contract for building the permanent structure over the Lan has been awarded to an English firm. There are to be five spans of 200 ft. each, and ten spans of 100 ft., and the contract price is about $115,000. The weight of the five spans of 200 ft. is 808 tons and of the ten 100-ft. spans, 365 tons. It will be another year before the road will be open as far as Shan Hai Kuan, where the Great Wall terminates on the shore of the gulf of Pechili. That will be an extension of about 75 miles beyond Kaiping, making the total length of line now working or under construction approximately 165 miles.



MAP OF EXISTING TELEGRAPH LINES IN CHINA.

(The narrow black lines and small circles indicate the telegraph lines and towns connected by them.)

A further extension beyond Shan Hai Kuan, however, is to be made as rapidly as possible. Surveys are to be pushed forward immediately in Manchuria to Kirin on the Sungari River, a distance of nearly 800 miles, through a rich, productive country. It may be presumed that the great incentive for the extension of this road is the military defense of the northeastern country against Russian encroachments; but its commercial importance is very considerable.

About a year ago the management of this line was placed in the hands of an American Assistant Managing Director, Mr. W. H. Pethick, who has practically absolute control of the road, the object of the Chinese being to test the advantages of foreign methods of administration, as compared with the Chinese system hitherto in vogue.

The road now in operation carries 2,000 passengers daily, which is sufficient evidence of its favor

in the estimation of the people. One of the principal sources of income, however, is the coal transportation from the mines at Kaiping, Tongshan and Linsi, to the seaboard at Tongku.

It is characteristic of the Chinese that with all their conservatism they are not blind to the needs of the country. While they will not submit to having innovations forced upon them, they will adopt those same innovations in their own good time, when the advantages thereof become obvious. The Taotai of Swatow is a man of advanced ideas. He has projected a line of railway from Swatow to the large inland commercial depot Chaochao, on the Pe River, a distance of perhaps 275 miles. A railway has been in operation along the west coast of Formosa River since some time in 1891. It begins at Kelung and is now open as far south as Taipeh.

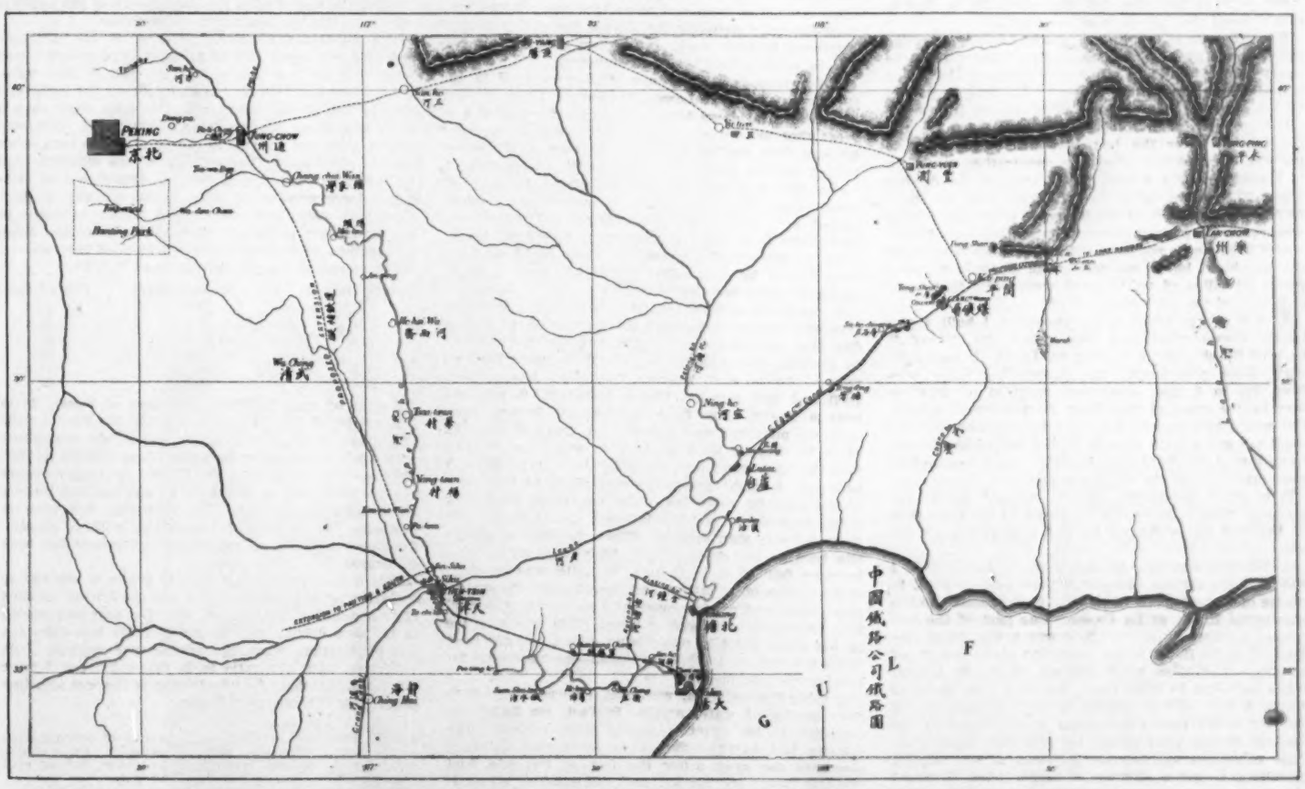
Another projected line is to run between Canton and Kowloon, opposite Hong Kong. This line will be about 127 miles in length. The greatest project which China has undertaken in the line of improved transportation, apart from the railway to the Sungari through Manchuria, is in connection with a road from Hankow to Lukow Kiao, near Peking. The surveys have not yet been made, but the construction of the road has been authorized by an imperial edict, which in itself is a new departure, and the work is intrusted to the two Viceroys, Li Hung Chang and Chang Chi-Tung, each having jurisdiction over his own section of the road. The distance between Hankow and Peking is over 600 miles in a direct line, so that the railway, following the usual course of travel, will be considerably longer than that.

The special interest attached to the building of this road is in the fact that it is to be constructed with rails made in China from Chinese iron. The Chinese have used iron utensils from very early times. Iron foundries are licensed by local officials to make common articles, principally for cooking purposes. Free trading in iron could not be permitted, for then rebels and pirates would be able to supply themselves with arms. The products of a foundry can only be sold within a designated area, each section having its own foundries, which hold the monopoly of the business there. Such has been and still is the law in China; but now that the government has established at Wuchang, a large manufacturing plant under foreign control for the manufacture of steel and steel rails, it is probable that the "rebels and pirates" will be able to obtain iron more easily in future. Perhaps they will take up a rail now and then—but I am of the opinion that the Chinese will leave that method of destroying life in the hands of the more "civilized" workingmen of the West, when they go on a strike against capital.

Such is the status of railway building in China at the present time; but there is a great deal more back of it to show that the thoughtful men of that country recognize fully the economical conditions which make the introduction of railways advantageous to the government and people. An editor of one of the native vernacular papers has discussed their importance for the quick distribution of grain to relieve districts suffering from famine, one of the frequent and most terrible visitations to which China is subject. In the fifteenth century it is estimated that 13,000,000 people perished in a famine. This was one of the worst known in history, but the loss of a million lives from such a cause is not unusual. This editor also tells his readers how railways have benefited other countries, and then declares that as the government is spending large sums on the navy and "the navy cannot pay a dividend," he thinks there is no reason why it should not "expend public money on a department of public works such as railways, which would pay well and recoup their cost in the course of time."

Not many years ago a newspaper that would venture to express such advanced views to the people of China would have suffered in consequence, but now not only are they acceptable, but there is a great and increasing demand for translations of foreign books on all conceivable subjects, which is being met by publications issued by the government—from the Kiangnan Arsenal for instance—and by the missionaries. Even the officials are beginning to take an interest in some of the schools for foreign instruction, giving them hearty encouragement. To appreciate the practical result of such a radical change in the educational system of the country, one need only read translations of some of the essays written by the students. In these we trace the influences of foreign studies upon the Chinese mind, and we are forced to admit that the results are gratifying to our highest expectations. I might extend this article and double its length to show how the future opportunities for American enterprise in China are already opening. Our people have ever been blind to their interests in foreign lands, and probably they will slight these opportunities as they have thousands of others. Yet we may hope that as the ranks of competent professional men are now so well filled, some of them will look abroad for new fields in which to exercise their genius and enterprise. It is true that so far as our representatives in Congress have had it in their power, they have, by their unjust and unwise treatment of the Chinese question, closed the doors of China against our people. I do not, however, despair of some means to counteract this influence, for I know that a great deal more is involved in it than our legislators can realize, and its importance should be forced upon their attention.

It is to be sincerely hoped that the Chinese will not be led astray by the action and influence of a few demagogues at Washington, for there is no doubt that the people of the United States as a whole desire to be friendly and just to the Chinese. Moreover, this desire springs from an innate sense of what is right and honorable, and does not originate in a wish to extend their commerce or to secure possession of territory in foreign lands by a mere semblance of friendship and unselfish interests such as China has experienced from other nations. However unwise and unjust our laws may be, for the moment, against the Chinese, those people should know that it is only in the one matter of exclusion that the United States has ever been in any sense unjust or unfriendly toward China, and even in this, it is not the American people who have spoken. I believe the Chinese do recognize this fact, and I still hope that they will remember that Americans have always been her best and most unselfish friends, and that in the future opening of the country, whether it be in the extension of her railways, the navigation and control of her rivers, the discovery and operation of her mines, or the establishing of government banks and mints for coinage, she will find the most friendly, faithful and efficient aid among the engineers and scientific men of the United States.



MAP OF PART OF CHINA, SHOWING THE RAILWAY CONSTRUCTED IN 1888, AND PROPOSED EXTENSIONS.

UNIFORM PRACTICE IN PILE DRIVING.
IV.

J. Foster Crowell: In reference to Mr. Trautwine's intimation that in most cases there would not be very low falls, I will state that the average stroke of a Nasmyth steam hammer in ordinary use would be from 2¼ to 3½ ft.; in ordinary circumstances, the weight of ram is, say, 5,500 lbs. If we take this weight with the full stroke, 40 ins., there would be developed a blow of 18,315 nominal ft.-lbs.; now, if we were to take a hammer of 2,000 lbs. and divide this value by the 2,000 lbs., we would find that we would require a fall of 9.16 ft. to produce the same blow, neglecting resistances in each case. Now, applying the Trautwine formula (later form) in the first case, you will find we obtain 70,368 lbs. as maximum load, but in the second case only 35,838 lbs., or just about one-half; that shows that this objection to the cube root is not a theoretical objection when the steam hammer is used, and I think those who have occasion to drive many piles will make more use of the steam hammer in the future than in the past.

G. Bouscaren, M. Am. Soc. C. E.—I think the trouble about applying a formula to pile-driving is that, in doing so, we gage the resistance of the soil from the penetration of the pile while it is being driven. It often occurs that the resistance of the soil is greater when the pile is being driven than it is after the pile is driven, and vice versa. Here are some examples which occurred in my practice:

In driving piles for trestles for railroads through Illinois, I had to adopt the rule to stop the pile-driving at the penetration of 1 in.; the hammer weighed from 1,800 to 2,200 lbs; the fall was about 25 ft. I generally found the rule to work very well.

When I came to build a railroad in Louisiana through the swamps of Lake Pontchartrain, I found that the penetration of a 65-ft. pile under the last blow of a 2,500-lb. hammer, falling 25 or 30 ft., was from 9 to 12 ins. Putting two of these piles, one on top of the other, and having a total penetration of 120 ft., the penetration under the last blow was still 9 ins. I thought I would see what the penetration would be if I gave the pile a rest, and I stopped the driving about 25 minutes after the pile had gone in about 40 ft.; the first blow of the hammer, when the driving was resumed, gave a penetration of 1½ ins. I concluded in this case not to consider the penetration under the last blow, but to use piles from 60 to 70 ft. long. About 22 miles of trestle-work were built that way, and none of the piles ever settled.

Here is a case which is the opposite: I built a pile trestle across what was then called the "Slough," back of Bloody Island, in East St. Louis. It was built with three pile bents, the penetration there was from 2½ to 3 ins., less than one-third of what it was in the case of the Lake Pontchartrain trestle, and within two weeks after the bridge was opened, we could not get a train over it; it had settled irregularly from 1 to 2 ft. That was in 1867, when locomotives were much lighter than they are now.

It is often impossible to tell, without actual experience, what reliance can be placed on the resistance of the soil as evidenced by the penetration of the pile.

C. Wheeler Durham, M. Am. Soc. C. E.—In 1870 I was engineer for the Chicago & Northwestern road, in charge of the extension of the line from Madison to the Mississippi River, at La Crosse. One part of the line crossed a marsh in which there was a stream of perhaps 30 or 40 ft. in width, requiring about 800 ft. of bridging. The piles were ordered 45 ft. in length. When we came to drive them, the piles went down to within a foot of the surface without a blow of the hammer at all, they were simply pushed down by the hammer resting upon them. We saw that these 45-ft. piles would not answer the purpose, so we stopped operations to get a new lot of longer piles. I forget exactly the circumstances which caused us to try these piles a second time in a day or two, but we found then that they did not budge under a fall from the full drop of the hammer; it would not stir them at all. So we pushed the balance of those piles down in the marsh for the 800 ft. of distance, capped them and built trestle-work upon them, and I suppose they are carrying the Chicago & Northwestern road to this day.

L. M. Haupt, M. Am. Soc. C. E.—I think it might be of interest to the members to know how piles were driven in this vicinity even without a hammer. On the Eastern Shore it is the practice in building small wharves for the fruit trade and light-draft steamers, to take the trees of the neighboring forests, and, after erecting a temporary staging with a projecting cantilever upon which two darkies can stand, a pile is placed between them, and is rocked to and fro, its toe resting on the bottom, until by its weight and swaying motion, it beds itself to the required depth. Any cessation of the movement causes the sand to settle and pack around the pile so quickly that it is impossible for the men to start it again. In this way the work is done very cheaply and efficiently, with an inexpensive plant. In the cases cited by Mr. Bouscaren, I think, possibly, the firmness of the piles in the Louisiana swamps is due to an under stratum of sand which settles around and clamps them in place. In the other case mentioned, back of St. Louis, there must have been some mud which was easily moved by a current. I should be pleased to know more about the sections through which they were driven.

William P. Craighill, M. Am. Soc. C. E.—I have just been informed of a peculiar case of pile-driving that occurred in some work in charge of a friend of mine who was improving the Caloosahatchee River, in Florida, where he had to drive piles, and had no pile-driver; the piles were of a kind that would not last long under the blow of a ram. The situation was peculiar; he disposed of it in the following way: Fortunately, he had a very fat man in his party, so that after placing the pile on end, he put this fat man on top of the pile; this gave the first motion to the pile. In order to keep up the interest in the subject, he got two or three men to shake the pile vigorously and try to shake the man off. That was the amusing part of the operation; they shook the pile and the fat man clung on. Fortunately, there was a water-jet available, so that with all these contrivances the piles were carried down to the rock, but I should like to know in the next edition of the formula the form it would take to cover that case.

W. M. Black, M. Am. Soc. C. E.—I cannot tell you very much about the bearing qualities of piles, but I would like to invite the attention of the Society to the lack of formulas and data regarding the safe load for piles sunk by the water-jet. This method of sinking piles is coming more and more into use. It has been used for many years by the United States Government Engineers in their work, and is now used quite generally in sandy soils all over the country.

Some years ago iron screw piles were used in the Government Pier, at Lewes, Delaware. In attempting to screw them down into position the friction was so great that several were broken by torsion. A water jet was then applied to the top surface of the screw blades, and the sinking was successfully accomplished.

The "five-load method" of pile-driving in the Caloosahatchee River, as described by Colonel Craighill, proved very effective. From 150 to 170 piles were sunk daily to a depth varying from 4 to 6 ft. in the sand, by the aid of a water-jet. These could not have been driven by the ordinary method, even had the necessary plant been available.

In Southern waters special precautions are necessary with pile work to avoid the ravages of the teredo. One plan is to use wood which they attack but little. In Florida, the palmetto is extensively used for this reason. As is well known, this wood has a hard shell and soft interior, like a cornstalk, it will not bear a heavy blow from a hammer. In one case palmetto piles had to be sunk to a depth of from 12 to 15 ft. through hard sand. This was done successfully by the water-jet, aided by light taps from a hammer. A slight protection was given to the point of the piles by sheet iron. The pile to be sunk was raised to position, and the hammer placed on it. The water-jet was then applied. When the descent of the pile became too slow, a light blow was given by a hammer fall of 3 to 6 ins. The pile was given a slight motion of vibration, and the pile and the water-pipes were kept moving constantly to prevent the sand from closing in and holding them. This seems to me an important point in pile-driving which has not been much touched on in this discussion—the necessity for keeping the pile moving.

In using the water-jet, we found it necessary to have the quantity of water ample. In fact, we found the essential to be quantity rather than velocity. The velocity had to be sufficient to cause the water to penetrate the sand below the foot of the pile, and make it "live" or "quick," and the quantity so great that the water had to escape by rising along the skin of the pile, preventing surface friction.

In the surveys of the harbors of St. Augustine and Key West, borings had to be made through the sand, to depths varying from 12 to 30 ft. This was done by means of the water-jet, and the method adopted illustrates its action. In compact sand a 2-in. pipe was coupled to the discharge pipe of a hand-pump, and forced down to a depth of from 5 to 10 ft. When it was stopped by the sand closing in on it, a 1-in. pipe was coupled in its place, lowered through the larger pipe and forced down to the required depth. The water rose along the surface of the small pipe, and through the annular space between the two pipes, bringing with it samples of the strata of sand penetrated. Thin strata of shell gravel were also bored through by this apparatus.

Charles Warren Hunt, M. Am. Soc. C. E.—At the pier at Lewes, Delaware, of which Captain Black has spoken, the piles were of solid wrought iron, from 22 to 45 ft. in length, and from 5¼ to 8 ins. in diameter, with cast iron screws 2½ ft. in diameter. When the work was in an experimental stage, the attempt was made to screw down the piles into compact sand with the aid of a jet of water forced between the flanges of the screws to the under side of the flanges. This was not successful, several of the piles being broken by torsion. An inspection of the screws developed the fact that the greatest friction was on the upper surface of the flanges, and it was found that, when the jet was applied to the latter, no more difficulty was experienced, and all the piles in the pier were placed in that way.

The gain by the use of the water-jet on these screw-piles was measured mechanically, and was stated in the report of the Chief of Engineers,* as follows: "That 9-10 of the total pressure on the rope which connects the power with the resistance at once disappears, in effect, on the application of the water-jet."

(A number of discussions relating to pile-driving by water jets only are here omitted.—Ed.)

F. P. Davis, M. Am. Soc. C. E.—I had occasion to drive some piles through very hard, compact sand, where it would take 200 blows of the hammer, falling from 20 to 30 ft., to drive the piles 20 ft. I have seen the piles stick, the water still being applied. By giving a light blow with the hammer the pile would take a sudden start and go from 4 to 5 ft., showing that the sand had been scoured out. I am satisfied the water-jet will scour the sand to quite a depth below the bottoms of the piles.

G. B. Nicholson, M. Am. Soc. C. E.—In the year 1883 I set up a turntable on a pile foundation in the lower part of the City of New Orleans, 2,300 ft. from the bank of the Mississippi River, for the New Orleans & North Eastern Railroad. As is generally known, the soil of that region is a compressible, wet alluvium, making the use of piles for the support of the pedestal of a turntable the best form of foundation.

The turntable I allude to was of the ordinary wrought iron type, and 54 ft. long. The pedestal was supported on a foundation of six yellow pine piles, freed from bark, 10 ins. in diameter at the small end and 14 ins. at the large end. The piles were capped with a grillage of two tiers of 12 × 14-in. creosoted yellow pine, and secured to the piles and to each other by 1-in. drift-bolts. The pedestal of the turntable was bolted on the top tier of timber. Experience in driving a large number of piles in the vicinity a short time previously had given me a great confidence in the sustaining power of piles having a rather large penetration, or sinking at the last blow of the ram.

The record of the pile-driving is as follows:

Length framed. Ft.	Set last blow. Ins.	Fall of ram.
35.5	12	35
34.5	12	30
27.5	12	35
30.	9½	30
29.5	18	35
27.5	9½	32

Weight of ram, 2,825 lbs.; number of blows, 25 to 30; weight of turntable complete, 32,400 lbs.; weight of grillage on top of piles, 3,700 lbs.; weight of engines, with tenders, using the turntable, from 116,000 to 156,000 lbs.—50% at present are 155,000 lbs.; approximate average daily use of turntable by engines and tenders since building, 13 times. The turntable has been in existence on its original foundation, without repairs, for nine years, and no appreciable settlement has been discovered.

It is a well known fact that if a pile is allowed to rest after being partially driven, and the driving resumed after a considerable interval, that the first penetration in the new driving will be considerably less than the last penetration, when the driving was stopped. I do not know what the ratio is in dry soils; but I have several illustrations for pile-driving in the wet alluvium about New Orleans, as follows:

Weight of ram. Lbs.	Fall of ram. Ft.	Penetration before resting. Ins.	Interval of resting. Hours.	Record of driving after resting. Penetration in inches, fall of ram in feet.
2,750	27	7½	48	0 / 1/2 / 1/2 / 1/2 / 1/2 / 1/2 / 1/2
3,000	35	6	24	1/16 / 1/16 / 1/16 /

First.—A pile penetrating 0.5 ft., with a 40-ft. fall of a 2,470-lb. ram, with the line attached to ram and slacked on the drum, penetrated 0.7 ft. with a 40-ft. fall when the ram was allowed a free fall by putting the line at the top of the leads.

Second.—A pile penetrating 0.7 ft., with 45-ft. fall of 2,750-lb. ram, with line attached to ram and slacked on the drum, penetrated 0.9 ft. when the ram was allowed a free fall by cutting the line.

Third.—A pile penetrating 0.32 ft., with 46-ft. fall of 2,500-lb. ram, with line attached to ram and slacked on drum, penetrated 0.40 ft. when ram was allowed a free fall by cutting the line.

A SPIRAL RIVETED PIPE LINE IN COLORADO.

The use of riveted sheet metal for water pipes, which was first practiced in the mining districts of the far West when ordinary cast or wrought iron pipe were unobtainable, has now become very general wherever minimum weight and cost are essential. The spiral riveted pipe of Messrs. Abendroth & Root has now largely replaced the old-fashioned straight seam pipe with stovepipe joint; and has shown itself capable of sustaining remarkably high pressures. The accompanying illustration is from a photograph of a line of spiral riveted pipe a half mile in length on Granite Mountain, Gunnison County, Colorado, laid to obtain power for mining purposes. The pipe is 15 ins. in diameter with flanged joints, and is laid above ground and quite unprotected. Water is taken from a small stream at the upper end of the line and is conveyed a distance of 2,500 ft. with a vertical drop of 400 ft., to the power house of the Magna Charta Silver Mining & Tunnel Co. The stream from the pipe drives a Pelton wheel of 350 HP. We are informed that notwithstanding the severe weather to which the pipe line is exposed, it has required no repairs since it was laid.

A WATER POWER FLUME ON GRANITE MOUNTAIN, GUNNISON CO., COL.

Another case of the use of spiral riveted pipe under heavy pressure is at Hesperia, Cal., where about eight miles of this pipe, varying from 3 to 14 in. diameter, has been in use since 1886 on an irrigation system, and in some places under a head of 400 ft. Mr. R. W. Widney, of Los Angeles, who has been the chief promoter of the Hesperia irrigation plant, states that the pipe has done good service and has never developed leaks.

THE USE OF SEA-WATER FOR STREET WATERING, SEWER FUSHING AND OTHER PURPOSES.

Mr. John William Cockrill, A. M. I. C. E., has been borough engineer and surveyor for the town of Yarmouth, England, since 1869, and in a paper lately presented to the Institution of Civil Engineers, he details his experience in the use of sea-water for various purposes as above indicated. This paper is here abstracted as follows:

The whole borough has a population of about 50,000, is situated on the River Yare, 2½ miles from the sea, and sea-water has been used continuously since 1869 for street watering. The town site is flat and narrow; the sewage is delivered directly into the river by short lengths of sewers with gradients ranging from 1 in 200 to 1 in 400; 1 in 500 being the flattest, and the water supply is private and the management and supply good. In 1882 the sewers were found to be in a bad state and about 13 miles of them were relaid, especial care being taken to have them tight and well ventilated. Automatic siphons or flushing tanks to the number of 14 were also put in, ranging in capacity from 1,600 to 3,000 gallons. The first six of these tanks were served from the water mains through a low-pressure meter delivering 200 to 300 gallons per hour to each tank. A movable iron flush-tank of 3,000 gallons capacity was placed over the head of the sewer, and could be emptied in one minute.

This system of flushing worked well, and kept all the sewers, old and new, in good condition. Previous to 1877 the water had been pumped from wells close to the river and was as salt as the river itself. But this system of water supply became expensive when the flushing system was introduced, and in 1884 the author prevailed upon the authorities to lay a complete set of mains for street watering and sewer flushing, at a cost of about $22,500.

There was some opposition to this scheme and delay followed. In 1885 the Local Board obtained from two eminent chemists their opinions on the desirability of using sea-water for watering streets and flushing sewers, with the following results: First, as to its use on the streets. There is no doubt that the street remains damp for a longer time than if fresh water were used. But its use is not to be recommended, says the committee. "1. Because the road in drying, we are given to understand, becomes very slippery and dangerous. 2. Because the salts present in sea-water are very hygroscopic. Hence in the case of delicate goods (such as silks, jewelry, etc.), injury is certain to arise from the dry dust blown about on a dry day and settling on these goods, becoming damp when the air contains a more than usual quantity of moisture. 3. Because the occurrence of nuisance from the action of the brine on the organic matter on the road and in the subsoil is certain to be complained of."

As to its use for flushing sewers.—"Its use is unadvisable. 1. Because the solvent action of salt water on organic matter is very inferior to that of fresh water. 2. Because where organic matter is in a state of solution in fresh water the addition of brine (sea-water) will effect the precipitation of the organic impurities. 3. Because (it follows, as a consequence of 1 and 2) if salt water be used for flushing, the quantity of suspended matter will be increased, and the deposit in the sewers likewise increased. 4. Because sea-water has an energetic action on metals and cements. 5. Because the sulphates, which are present in large quantity in sea-water, are certain to be reduced by fermentative action, while from the resulting sulphides any acid will generate sulphureted hydrogen. Thus the nuisance arising from flushing sewers with sea water may be considerable."

The experts in conclusion said: "We are strongly of opinion, therefore, that it is most undesirable to use salt water, either for road-water or sewer flushing on the two-fold ground of injury to property and injury to health."

After this opinion was given an inquiry was held before Mr. Codrington, M. I. C. E., by order of the Local Board, and Mr. H. P. Boulnois, City Engineer of Liverpool, gave evidence in favor of the scheme, with the final result that the work was carried out on the author's plans. The plant included an 8 HP. Otto gas engine operating a pump of 25,000 gallons daily capacity; a brick tower, 44 ft. high, carrying a 23,000-gallon tank; an 18-in. pumping main 700 ft. long to the tank, and a distribution system of 9 miles of 3 to 7 in. iron pipe, coated with Dr. Angus Smith's composition. The hydrants, 42 in number, are not over 800 ft. apart, and 40 valves, of 3 to 6 in. diameter, were put in for sewer flushing. After three years trial this system was extended to the portion of the borough on the other side of the river, at a total cost for the salt water supply to the town of $35,000.

It should be stated that before the first scheme was submitted, the author wrote to the engineers and surveyors of a number of seaside towns, and the following gives, in a condensed form, the

information which he was then able to lay before the Council, with the original scheme:

Birkenhead.—"One spread of salt water on the surface of a street or road is equal to about three spreads of fresh water, as the latter under the heat of the sun evaporates, whereas the salt water leaves a crust on the surface and keeps down the dust for a considerable time. We have not yet flushed our sewers with salt water."

Hastings.—"Sea water has been used in this town for some years for street watering and sewer flushing, and no inconvenience has been found to arise. There is, perhaps, rather more mud on the roads during the autumn, but, on the whole, I believe that sea-water has a good sanitary effect on both roads and sewers."

Worthing.—"Many of our streets are watered with sea-water, and have been for years. The effect upon roads is to bind them together almost like cement; dust is never seen on these roads when dry, and sea water keeps damp at least as long again as fresh water. Such an argument as sea-water acting upon sewage so as to make it offensive is simply absurd."

Eastbourne.—"We thought of using sea-water some years ago, but as there was a general objection to it we gave it up. From what I have seen of its use, my opinion is that it materially assists the solidifying of a road."

Brighton.—"We do not use sea-water for street watering, but we use it for flushing our main intercepting sewer, and if used in sufficient volume it is not offensive."

Blackpool.—"This corporation has used sea-water for street watering and sewer flushing for some time, and I find no complaints arise whatever, but sea-water makes sett-paving slippery."

Ryde.—"I can state confidently after 30 years' experience in the use of salt water for watering roads, that so far from deteriorating macadamized roads, it hardens the surface, so much so, that during the recently dry summer we found that in streets with a gradient of 1 in 12, when it was necessary to water a second time in the day, we were compelled to use fresh water, otherwise the streets would have become too slippery. Doubtless, after a long course of salt water on a level road, when rain first comes, the surface will be a little dirtier than if fresh water had been used. We find it pays to use salt water when a load of water costs twice as much as fresh. With reference to flushing sewers, I am disposed to think that the contention of your water company is right, but in this matter I have had very little experience."

Rhyl.—"Sea-water will not injuriously affect macadamized roads, but have a good effect."

Torquay.—"I have used sea-water for street watering upon macadamized roads for several years, and do not find any inconvenience; but if there is any difference between salt and fresh water, I think the salt water is preferable.I do not use salt water for flushing, except very rarely in the low level, and then I do not find any smell more offensive than at other times."

Margate.—"Had no special means of raising salt water, and so gave it up; when used, one load went as far as three loads of fresh water."

Plymouth.—"All the low levels are watered with it; consider that two loads of fresh water are not equal to one of salt."

South Shields.—"One load of salt water equals four loads of fresh."

Tynemouth.—"Has a very good effect upon street surface, as it hardens the surface of macadamized roads; we use it for watering, flushing, and baths."

Barrow-in-Furness.—"Use salt water for street watering; when fresh water used it took twice the quantity."

Ilfracombe.— "Used sea-water formerly, and contemplate doing so again. It retains its effect twice as long as fresh water, and it is very binding."

In addition to the foregoing, the following opinion of Mr. H. P. Boulnois may be quoted: "Watering the streets with sea-water should be adopted wherever it is feasible, as it not only gives a delightful freshness to the air and dispels iodine, but it also causes the surface of the street to maintain its humidity for a longer period than when fresh water is used, as it impregnates the soil with hygrometric matter. This has been often attempted artificially by adding common salt to the water used for watering."

The general results may be stated as follows: Since the construction of the works the consumption of water for street watering has been annually less than 5,000,000 gallons at 5 cts. per 1,000 gallons, instead of 7,000,000 gallons at 24 cts. per 1,000 gallons, as before. There is also a considerable saving on the gravel and flint for macadamized roads, and the author believes that these roads can be maintained for about 15% less than when fresh water was used. The salt water does not seem to hurt them in any way. During the summer months the dust is kept under by the qualities of salt water; and in the early autumn, if the surface coating is removed by the broom upon the appearance of the first frost, no evil effect is traceable to the use of salt water. No complaints are made by shopkeepers, jewelers, etc., and the three reasons urged by the committee of chemical experts have given no cause for anxiety.

Used in sewer flushing, salt water has cleaned them thoroughly and after five years' experience no nuisance of any kind has followed. Its effect in the Yarmouth sewers has been to reduce and almost prevent the generation and accumulation of sewer-gas. Sewers can now be entered at once on the removal of the manhole cover; which was not the case before. An 18-in. pipe sewer on a gradient of 1 in 300 was formerly constantly clogged by deposits; it is now kept thoroughly clean by two flushes per day from a 3,000-gallon tank, which fills the sewer two-thirds full. There are no deposits of any sort in the sewers, except in several of the larger ones, and there it has been reduced one-half since salt water has been used. As to the effect of salt water on iron, the author says that the siphons are of galvanized sheet iron only, but they have required no repairs since they were put in. As to the sulphates in seawater, no evil effects are traceable; the town possesses no manufactories and no acids are discharged into the sewers.

The salt water has never been used for extinguishing fires, though it is available if needed. The author does not recommend it for this purpose, as he considers that a dwelling would not be habitable after its walls had been saturated with sea-water. It is used for private baths with satisfaction to the users. Mr. Cockrill concludes by commending the use of salt water for the purposes stated and thinks that a supply of 40,000,000 gallons a year, could be raised and distributed for from 4 cts to 8 cts. per 1,000 gallons, resulting in a great saving as compared with the use of fresh water.

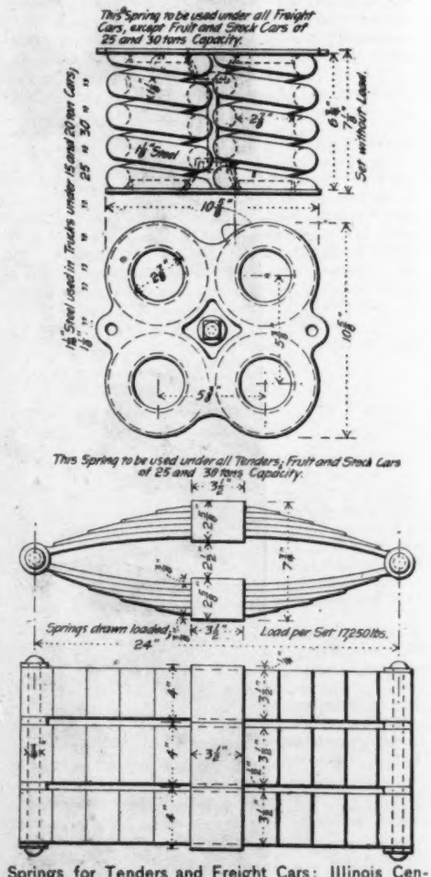
WORLD'S COLUMBIAN EXPOSITION.

(With inset.)

Special Passenger Cars for Exposition Traffic; Illinois Central R. R.

The enormous local traffic which will have to be carried next year between the city of Chicago and the Exposition grounds will require a considerable addition to the present suburban rolling stock of the railways handling this traffic. A large proportion of the rail traffic will be over the Illinois Central R. R., and the officers of that road have had to consider the question of providing ample car equipment without incurring too great an expense. Such an addition to the suburban equipment is not required permanently, and it has therefore, been decided to build a number of special cars, so designed as to be readily convertible into fruit cars or stock cars for special freight traffic. These cars have been designed under the the supervision of Mr. Henry Schlacks, Superintendent of Machinery, of the Illinois Central R. R., and Mr. Wm. Apps, Master Mechanic at the company's car works at Chicago, and we are indebted to Mr. Schlacks for drawings and specifications from which our illustrations and description have been taken. The improvements in roadway, etc., now being carried out by the Illinois Central R. R. to facilitate the handling of the Exposition traffic, and the expenditures for these works and special equipment, were described in our issue of Oct. 13.

A special point in designing cars for this service was to secure as large a carrying capacity as possible, combined with ample means for rapid entrance and exit of passengers, so as to load and discharge passengers promptly and run the trains with as little delay as possible. It will be noted as a matter of particular interest that the English arrangement has been partly followed, with some modifications. The interior of the car is open from end to end and divided by seven rows of transverse seats, forming eight compartments in which the passengers sit facing each other. The cars are 35 ft. long over the sills, 8 ft. 6 ins. wide over the sills, 6 ft. 8 ins. high at the side doors and 7 ft. 9 ins. high inside in the middle. Referring to the adoption of the English system, it may be said that by this system there is a doorway to every eight or ten persons, while with the American system there are but two doors to a car. With cars like those of the New York elevated railways, with only two doors and having seating capacity for 48 passengers, and carrying nearly double that number during the busy hours, there is a great amount of crowding and inconvenience. On the Brooklyn Bridge cable railway this dangerous and unpleasant crowding at the doors has been somewhat reduced by providing a wide doorway in the middle of each side of the car. It has frequently been said that the English city and local trains make longer stops at city stations than the trains on the New York elevated railways, but this is probably due in part to the fact that the English trains are not handled so promptly and that the passengers have to find cars of the class for which they hold tickets. By the English system the same amount of traffic would probably be handled very much more quickly here than in England, owing to the one class of car and more prompt handling of the trains. As stated in our issue of Jan. 30, 1892, probably one of the best systems for handling a very heavy city traffic would be to have a middle platform and two outer platforms at each station, and to use cars with a side door at each end of the car on one side only for entrance, and a wide middle door on the other side for exit. The special cars of the Illinois Central R. R., however, are not intended for permanent use, having no doors and no high partitions, so that cold, wet and draft would make them impracticable for any but summer traffic. A description of the London local trains and traffic was published in our issues of May 2 and June 10, 1891.


This Spring to be used under all Freight Cars, except Fruit and Stock Cars of 25 and 30 tons Capacity.
Set without Load.
This Spring to be used under all Tenders, Fruit and Stock Cars of 25 and 30 tons Capacity.
Springs drawn loaded
Load per Set 17250 lbs.

Springs for Tenders and Freight Cars; Illinois Central R. R.

The frame, ends and roof of the special cars are of the standard style used for freight cars. The sides will be of special construction, with eight doorways on each side, 6 ft. 8 ins. high and 22 ins. wide, these doorways being provided with curtains for use in wet weather, and provided also with bars operated simultaneously by means of a lever at one end of the car, as shown on the drawings. The bodies will be carried on the standard pattern of truck for engine tenders and freight cars of 50,000 lbs. and 60,000 lbs. capacity, except that ellipti-

cal springs will be used, as for tenders, fruit and stock cars, instead of the helical springs used for ordinary freight cars. The side bearings will also be fitted with rubber blocks. There are no side steps, platforms level with the car floors being provided at the stations. When the Exposition is over the seats will be removed and the ordinary sheathing and freight car doors put on.

The cars are to be built from drawings and specifications furnished by the Illinois Central R. R. They will be 35 ft. long over side sills, and 8 ft. 6 ins. wide over end sills. The height from bottom of sills to top of plates will be 7 ft. 5 ins.; from top of rail to center of drawbar, 2 ft. 11 ins.; and from rail to top of car about 12 ft. All sills and plates must be mortised for posts and braces for standard 30-ton box car in addition to the posts and braces for the Exposition cars. All mortises running into each other must be securely plugged to fill up extra mortises, and thoroughly saturated with Princess metallic paint. Plugs are to be securely fastened in with nails. All longitudinal sills are of southern pine dressed to 5×9 ins., and end sills of white oak 7×9 ins. The flooring to be of well seasoned Norway or southern pine, 1¾ ins. thick, shiplapped ⅝-in., and 5 to 9 ins. wide; fastened to every sill by two or three 4½ in. steel barbed wire No. 6 nails. All bolts through draft timbers must be fitted with socket washers to come even with top of floor. Before the floor is laid the tops of sills must have a heavy coat of Princess metallic paint and oil. The car will be sheathed inside and out with the best grade of white pine or poplar, nailed to plates, sills and girths and all face nails punched 1-16-in. beyond face of siding. Letter boards and crown moldings will be of yellow poplar or white pine nailed to posts and plates with 2½-in. No. 8, steel barbed wire nails with small heads, and one 2¼-in. No. 16 flathead screw at each post and 1 in. from bottom of signboard; these screws to be countersunk and glue-plugged. The car lines will be of ash, dressed and chamfered and securely fastened to plates. The roof boards will be of the same quality and dimensions as the siding, laid dressed side downward and each board nailed to each carline with two 2¼-in. No. 9 steel barbed wire nails.

The roof will be covered with first quality IX bright tin sheets 20×28 ins., double screwed with ½-in. lap and each sheet fastened down with eight ¾-in. No. 13 tinned barbed wire nails. The heads to be well covered with the seams, well soaked in with solder entirely across the seams. The tin will extend over and lap down 1¼ in. over the front of crown molding and door capping, and nailed to same with 1-in. steel-barbed tinned wire nails not over 1 in. apart. The running boards will be made of four widths of southern, white or Norway pine, ⅞×5½ ins., laid 1 in. apart, to break joint, and fastened with three 2½-in. No. 18 flat head screws at each heading joint; and two 2½-in. No. 7 steel barbed wire nails at each saddle in each board. A piece of tin 5½×5½ ins. to be nailed over all heading joints to cover screw heads and exclude moisture. At each carline will be a running board saddle fastened to the roof tin by tin cleats 4×8 ins., soldered to roof tin and nailed to saddle by 1 in. No. 12 steel barbed wire tinned nails. Tin lugs to be soldered to roof under each end of every saddle to prevent whole length of saddle resting on the roof. A small platform or running board, of same material as main running board, to be at the brake staff, and another at the opposite corner of the roof. Roof grab irons at brake staff and opposite corner of roof must be fastened to the short running boards with ½-in. bolts through roof and platform, having nut on top of handle and riveted over. A washer 1¼ in. thick, of sheet rubber 2×2 ins., to be put between platform saddle and tin roof to prevent water from getting in around bolt holes. The main running boards will project 6 ins. over the ends of the car, and be supported by four wrought iron strap brackets ¼×1¾ ins. Roof tin and saddles to have a coat of Princess metallic paint.

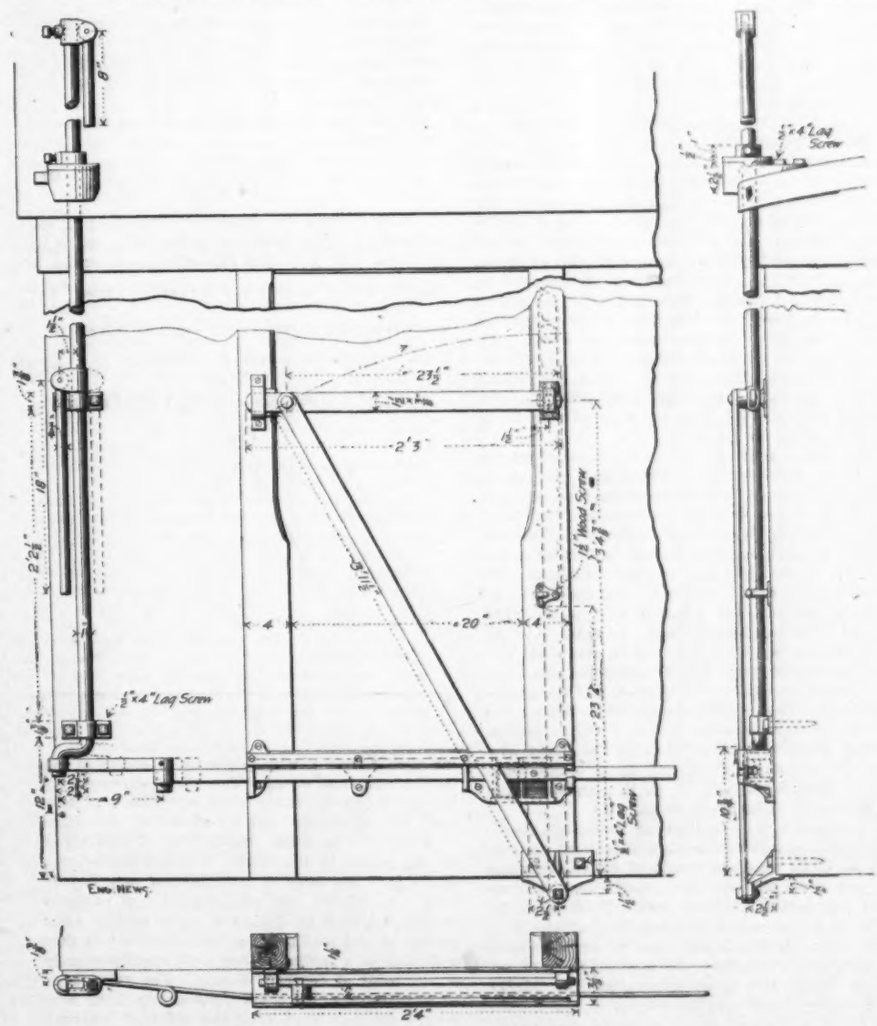
There will be 14 windows to each car, with an upper pane of plain ground glass 12×20 ins., and the lower pane of clear glass 20×24 ins. Sashes to be of red cherry or mahogany, fastened in position.

The outside sheathing will be of yellow pine or poplar, smoothly dressed, brought to a smooth finish painted with three coats of Illinois Central standard coach color, and finished with two coats of varnish. The inside to be given three coats of Illinois Central standard baggage car color and one coat of varnish. Roof and running boards, trucks and outside of wheels to be painted with Princess metallic paint (three coats to roof, two to woodwork of truck and one to ironwork of truck) purchased of Johnson, Heath & Milligan, Carey Ogden, of Chicago, or Le Gros, of Louisville, Ky. Cars to be lettered and numbered in gold shade paint. Each car will have a lamp at each end, placed at opposite corners, and furnished with Adams & Westlake smoke jacks as used on the day cars.

The American continuous draw gear will be used. The drawbars will be of the M. C. B. standard vertical type, furnished either by the railway company or the builder, and equipped with automatic couplers if required. The drawbar springs will be two-coil round bar crucible steel, with a capacity of not less than 200,000 lbs. Safety chains and hooks will also be provided at each end of the car. The corner bands will be of Schoen pressed steel, those on lower corners having push pockets. The cars will have automatic gates for the protection of passengers as shown, and an extra platform provided at same end as, but opposide side from, brake staff, with a footguard on outer end, for the protection of trainmen when operating the gate lever.

All cars will be equipped with the Westinghouse automatic air brake, applied to both trucks, and having the Hodge system of leverage. The latest form of Westinghouse conductor's valve for passenger cars is to be fitted, being placed under the rear seat and securely inclosed with a wooden box. A ⅜ in. rod is to lead up to the roof, having a handle which rests on the roof when the valve is closed. Each car will be fitted with a combination signal lamp and flagstaff bracket, of the railway company's standard, at each corner of the crown molding. They are made of best malleable iron and can be purchased from the New York Signal Lamp & Lantern Co., of New York, N. Y. Each car will also be fitted with brass bell cord bushings at inside and outside of end plates and five brass bell cord guides, all made by Adams & Westlake, of Chicago, Ill. A curtain is to be placed at each door opening and hung on top to a ½-in. round rod. Each curtain will have six rings of No. 8 brass wire 1 in. diameter. Each curtain will also have six carpet gromets, with carriage curtain nails and black leather strap 1¼ in. wide by ⅛ in. thick to fasten the curtain back to the post.

The specifications for material require that white oak must be clear of heart, large, loose or defective knots, sap, wind or heart shakes. White pine must be of good quality and free from large, loose or defective knots. Yellow pine and poplar must be virgin and show one face clear of sap, the other side to show not less than two-thirds heart and to be free from large, loose or defective knots, wind or heart shakes and injurious sap. Oak and ash must be of a good quality and free from large, loose or defective knots, heart shakes or injurious sap. Cherry for sashes must be of the best quality and free from wind shakes and breaks of any kind whatever, and free from sap or wave. Ma-



GATE ARRANGEMENT OF SPECIAL PASSENGER CARS FOR WORLD'S COLUMBIAN EXPOSITION; ILLINOIS CENTRAL R. R.

hogany may be substituted for cherry, but must be of the same quality as specified for cherry. All bar iron forgings, bolts, nuts and rods, must be of fibrous, tough, even grained, good neutral iron. The iron must have a tensile strength of 48,000 lbs. per sq. in., 15% elongation in 8 ins., and must be capable of bending cold without fracture, through 90° to a curve whose diameter is not more than twice the thickness of the piece. A good brand of iron must be used for the mixture of all castings. Tensile strength not less than 18,000 lbs. per sq. in.; for tranverse strength, unfinished specimens, 1×1 in. square, on supports 12 ins. apart and loaded in the center, must stand not less than 3,000 lbs. before breaking.

A sample car, complete in all its details, has been built by the Illinois Central R. R. at its car works at Chicago, Ill.

Standard Freight Car Truck; Ill. Cent. R.R.

The special cars above described will be carried on the railway company's standard pattern of truck for tenders and freight cars of 25 and 30 tons capacity. The truck has a diamond frame, wooden bolster 12 ins. wide by 10½ ins. deep, with two 1¼-in. truss rods, and a 15-in. channel iron spring plank. The trucks have 36-in. double-plate cast iron wheels, and a wheel base of 5 ft. They will have double elliptic springs guaranteed to stand a load of 6,975 lbs. each, including the car body, or a total of 27,900 lbs. including the car body, with a clearance of 1¼ ins. between bands when loaded. The springs are not to be over 30 ins. long, c. to c. of end bolts. These springs are used under tenders and under all fruit and stock cars of 25 and 30 tons capacity. For all other freight cars helical springs are used, placed in groups of four, as shown on the drawings. The draw bar springs will be two-coil round bar crucible steel with a capacity of not less than 20,000 lbs. The center plates will be Schoen patent pressed steel for 10-in. body bolster and 12-in. truck bolster, 3¾ ins. high between bolsters. Standard oil boxes for 30-ton freight cars will be used, and fitted with Fletcher-Morris pressed steel lids, the face of box being machine fitted for the lids.

The journal bearings are M. C. B. standard for 4¼×8 in. journals, composed of one part of tin and eight parts of Lake Superior ingot copper, and to weigh not less than 15 lbs. each, and lead lined 3-32-in. thick on the journal bearing side. All bearings to be machine bored before lead lining is put on, or, if desired, the railway company will furnish its own standard bearings at 15 cts. per lb. at its Chicago car works. The journal bearing keys will be M. C. B. standard for 4¼×8 in. journals, made of best grade malleable iron. The King flexible side bearings for railway cars will be used, and are manufactured by Vose, Cliff & Co., of New York. The Westinghouse automatic air brake will be applied to both trucks of each car, having the Hodge system of leverage. The Detroit metal brake beam will be used, fitted with M. C. B. standard brake heads and Congdon brake shoes.

The wheels will be the railway company's standard 36-in. cast iron double plate Washburn pattern, with M. C. B. standard tread and flange, weighing not less than 690 lbs. each, and have chill on tread not less than ⅝-in. deep. They must be made of a mixture containing 50% of the best Lime Rock Salisbury pig iron, to be purchased of Barnum & Richardson, the balance being of old wheels. They are to be guaranteed for 70,000 miles or five years' service, subject to fair usage. The axles will be of No. 1 wrought iron scrap, double worked, and weighing not less than 440 lbs. when finished. The wheels to be pressed onto the axles at a pressure of 38 to 42 tons. Distance throat to throat of flanges, 4 ft. 7⅞ ins. One wheel out of every hundred will be selected at random and tested under M. C. B. rules.

The material for one standard truck for tenders and for freight cars of 25 and 30 tons capacity is as follows:

Material for Car Truck.

1	bolster, oak	10½ × 12 ins. × 7 ft. 6 ins.
2	truss rods, wrought iron (1⅝ in. end)	1¼ × 8 ft. 0 ins.
1	channel iron " "	4 × 15 ins. × 7 ft. 4 ins.
2	arch bars, top, wrought iron	¼ × 4 ins. × 5 ft. 11½ ins.
2	inverted arch bars " " for all freight cars	1¼ × 4 ins. × 6 ft. 10 ins.
2	inverted arch bars, wrought iron, for tenders	1¼ × 4 ins. × 7 ft. 2 ins.
2	pedestal tie bars, wrought iron	⅝ × 4 ins. × 6 ft. 8 ins.
4	pedestals, cast iron	17⅛ ins. bet. shoulders.
2	truss rod plates, wrought iron	1 × 4 ins. × 1 ft. 1½ ins.
1	truss rod bearing, " "	½ × 4 ins. × 1 ft. 2 ins.
1	truss rod bearing block, oak	1¼ × 4 ins. × 1 ft. 1 in.
4	journal boxes, cast iron.	
2	axles, wrought iron	journals, 4¼ × 8 ins.
4	journal box covers, steel	
4	journal bearings, brass, M. C. B.	standard 60,000 lbs.
4	tie bars and channel bolts	⅝ in. × 3¼ ins. long.
4	journal bearing keys	M. C. B. standard, 60,000 lbs.
4	bolster guide blocks, cast iron	
2	side bearings " "	
1	center plate " "	
2	sets of elliptic springs for tenders, fruit and stock car, steel	24 ins. long, 7⅝ ins. set.
2	sets of helical springs for all other freight cars, steel	7⅛ ins. set.
8	pedestal bolts	1⅛ × 23¼ ins.
8	journal box bolts	1 × 15⅞ ins.
4	journal box cover bolts	⅝ × 4 ins.
6	guide block rods	⅝ × 15¼ ins.
8	side bearing lag screws	⅝ × 4½ ins.
8	pedestal bolts	⅝ × 2¾ ins.
4	tie bars	⅝ × 4 ins.

ANALYTICAL DISCUSSION OF THE MOST ECONOMICAL VALUE OF $\frac{l}{r}$ IN THE GORDON FORMULA.

By Wm. W. Crehore.

Since Gordon's well-known empirical formula for columns has been shown analytically to be correct,* we may enter profitably into analytical investigation of the same without having our premises questioned.

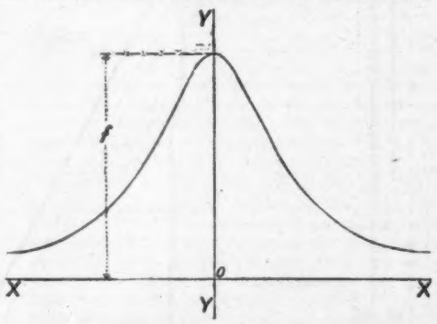
The Gordon formula may be written in general as follows:

$$y = \frac{f}{1 + a\left(\frac{l}{r}\right)^2} \qquad (1)$$

in which f and a are constants determined by experiment, l is the length, r is the least radius of gyration, and y is the allowable unit strain, a quantity which varies when the ratio $\frac{l}{r}$ varies. For convenience let us write x for $\frac{l}{r}$ and we have

$$y = \frac{f}{1 + ax^2} \qquad (2)$$

A plot of this equation (see Fig.) about rectangular axes X and Y will enable us to arrive at our conclusions more easily. The curve shows that y has its maximum value when the ratio x is zero, and its minimum value when x is either $+\infty$ or $-\infty$; in other words the X axis forms an asymptote to the curve. Further observation shows that the value of x diminishes very rapidly from $+\infty$ toward zero until the point of contrary flexure is almost reached, and again rapidly after having passed that point a little distance; so that the value of x is diminishing least rapidly exactly at the point of contrary flexure. The value of y on the contrary, increases quite slowly from zero toward its maximum until the point of contrary flexure is almost reached, and again slowly after having passed that point a little distance; so that the value of y is increasing most rapidly exactly at the point of contrary flexure. Now, in designing a light column, the larger y is the better until we find y increasing at the expense of x, which it does when $x\left(=\frac{l}{r}\right)$ is nearing zero. For when $\frac{l}{r} = 0$, either l must equal zero, or r must equal infinity; an approach to either of which conditions gives an abnormal (not to say "uneconomical") section in the column. Consequently, the most useful values of x and y are those which are diminishing and increasing least and most rapidly respectively. These values lie near the point of contrary flexure of the curve, and the value of x giving the most economical unit y will be found exactly at that point.



At the point of contrary flexure the tangent of the angle made by the direction of the curve and the X axis is greater than at any other point on the curve. To ascertain the value of x for the maximum value of the tangent we must differentiate twice and put the second differential coefficient equal to zero.

Differentiating (2), we obtain

$$\frac{dy}{dx} = -\frac{2fax}{(1 + ax^2)^2} \qquad (3)$$

And again

$$\frac{d^2y}{dx^2} = -\frac{2af}{(1 + ax^2)^2}\left[1 - \frac{4ax^2}{1 + ax^2}\right] \qquad (4)$$

Putting $1 - \frac{4ax^2}{1 + ax^2} = 0$, we have

$$x^2 = \frac{1}{3a} = \left(\frac{l}{r}\right)^2 \qquad (5)$$

And substituting this value of x^2 in (2) we obtain

$$y = \frac{3}{4}f \qquad (6)$$

We must conclude, therefore, that equations (5) and (6) give us values of the ratio $\frac{l}{r}$ and of the unit stress y which are most economical, and the nearer we can approach these values in practice the better.

It is not considered necessary in a discussion of this nature to work out a concrete example in application of the general truths here reached. The writer, however, will be glad to pursue the subject more practically for any one who may desire it.

* See pp. 289-301 of "Mechanics of the Girder," by John D. Crehore, John Wiley & Sons, 1886.

HIGHER SPEED OF RAILWAY TRAINS.*

We are told that Stephenson nearly defeated his object, when advocating the first steam railway, by asserting that trains could be moved at a rate of 12 miles per hour. This was soon accomplished, and then began the cry for higher speed. To-day, with trains running regularly at 40 to 50 miles per hour, the cry still continues, and increases in a direct ratio with the increase of speed. It is the duty of the railway manager to comply with all reasonable demands of the public. The public demands higher speed. Is it practicable to comply? If not, then the demand is unreasonable.

In my opinion the question as to railway speed may be answered by saying that (within a certain limit, of course) any speed is practicable which the public will pay for. When the public is willing to pay for a three hours' ride between Boston and New York, it can be accommodated with as good a degree of safety as it now enjoys while making the journey in six hours. That locomotives can be built capable of attaining a speed of 80 or 90 miles an hour, with light loads, is beyond question; and we can conceive of a railway so constructed as to admit of such a speed with reasonable safety. But that such a road can be built and operated so as to render a fair return upon the capital invested, I believe is a question not worthy of serious consideration at the present time, although it may not be out of place to mention a few of the reasons which, to my mind, render it practically impossible to attain such a speed, for a long time to come at least.

One of the most important things, perhaps the most important, to be considered when we start a train is our ability to stop it. Mr. Geo. Westinghouse, Jr., (I suppose the highest living authority) tells us that with a perfect brake acting upon all the wheels of an express train running at a speed of 90 miles an hour, at the end of ten seconds after the application of the brake the train would still be moving at 60 miles an hour and would have traveled 1,130 ft. It would be brought to a stand in about 1,200 ft. more, or 2,330 ft. in all. But under the best actual conditions now existing, at the end of 16 seconds the train would be moving at 61 miles an hour and would have to travel about 1,800 ft. further to come to a stop. With this fact staring us in the face it seems a waste of time to talk of running trains at such speed on our present tracks and in connection with the ordinary passenger and freight traffic. The question then is: Is it possible to put our present railways in condition to meet the necessary requirements, and if it is possible, is it a practical proposition? To the first question I would answer, yes; to the latter, no. I say no because there is no reasonable probability that it would result in a sufficiently increased revenue to warrant the outlay. The necessary changes in roadway and track would amount, practically, to the relocating and rebuilding of our roads.

Mr. Theodore Voorhees, an authority on high speeds,

* A paper by C. A. McAlpine, Supt. Northern Division Old Colony R. R., read before the New England Railroad Club.

tells us that an ideal railway would be perfectly level and straight, with a roadbed and track heavy, substantial and well drained, with no grade crossings or openings to invite trespassers; with bridges whose floors should be as solid as the road-bed itself, and with stations so planned that no passenger could ever set foot on the track. I would add to this that these tracks must be devoted exclusively to high speed trains and must be located at a sufficient distance from all other tracks and from each other to avoid the danger, ever present with us now, of an accident on one track causing a ten-fold worse one on another. Add to this a perfect system of signals, constructed with due regard to the capacity of the human eye, and operated in connection with a mechanical device automatic and positive in its action, which will, in the event of a failure on the part of an engineman from any cause to obey the signal, bring a train to a stand before reaching the danger point. Then with equipment constructed of the best material and under the most rigid inspection, we may travel on such a track at 80, 90, or even 100 miles an hour with comparative safety. All of these requirements can be met, but only with unlimited capital; and I fear that none of us here will ever see the ideal realized.

Leaving, then, the question of extraordinary speeds to theorists and the future, is it practicable to make any increase in the average express train speed on what may be termed our first class railways? Assuming 40 miles an hour as the present general average and 45 miles an hour as a special average, can we increase these speeds by, say, 25%, making them 50 and 60 miles an hour, and to what extent does it involve the ordinary or local traffic? What system and appliances are necessary to accomplish it? Is our roadway and track safe for such increase, and, if not, can it be made so at a reasonable outlay?

Taking these questions in reverse order, roadway and track are the first essential to high speed. I do not think it necessary to devote much time to their consideration in connection with the subject now before us, as the improvements now being made on most of our trunk lines are fast bringing them into a condition to render them, so far as the track is concerned, more safe for a speed of 60 miles an hour than they formerly were for 30 miles an hour; in fact, many roads have already reached that condition. Solid masonry, iron and steel have taken the place of the loose field stone and wood in bridges and culverts; crushed rock and gravel, that of loam and other inferior material as ballast; steel rails have been substituted for iron; the number of cross-ties has been largely increased; the weight and strength of the rail and of all parts of the track proper have been nearly or quite doubled; dangerous curves have been straightened; grade crossings are being abolished or more securely guarded; safety switches are almost universal, and the facing point is rapidly disappearing. With these and other improvements made and being made, we may safely answer this question in the affirmative.

Taking next the question of appliances; the motive power would seem to be first in order. Few outside of the men who have brought the modern locomotive to its present development realize the wonders of the machine or the enormous power developed daily. What future development is needed in the locomotive to increase the average train speed by 25%, I will leave for these men to discuss, and answer, fully believing that it can and will be accomplished whenever demanded by the financial and operating departments.

I want, however, to bring up a question which has long been in my mind and is brought out forcibly by a series of tests and records made on one of the "Shore Line" trains between Boston and Providence, and which is a fair sample of express train service in New England. This train is scheduled to make the run of 44 miles in 65 minutes, including two stops.

Making the liberal allowance of five minutes for the two stops it will be seen that it is only necessary for this train to make an average of 44 miles an hour; and yet it was found that on seven of the eight trips covered the speed during some parts of the run exceeded 70 miles an hour, and on one occasion reached 77¼ miles an hour. There is nothing exceptional about this train; equal fluctuations will be found to be the rule, particularly in New England.

From this it appears that with a locomotive capable of maintaining the average speed on the up grades existing on nearly all roads, we may increase our speed to 50 or 60 miles an hour without any actual increase in the rate which we are daily reaching, and, owing to the fact that a train can be brought to a stop within a much less distance on an up grade than on a descending or level track, with no increased risk. My question then is: Do we not want more power in the locomotive rather than more speed, and is it not possible to bring this about? Otherwise does not an increase of 25% in the average mean a maximum rate beyond the safety limit? In other words, can we not best increase the speed by making it more uniform? Next in order and importance, after getting our locomotive to give us the speed, comes the brake to control it. Notwithstanding the wonders already achieved, much remains to be done in this line; experiments have demonstrated that at 60 miles an hour the braking force should be double that usually employed; we must have that force and it must be applied to every wheel in the train, not excepting the locomotive trucks. One of our Boston roads has recently applied the truck brake to some of its locomotives with such good results that a large number have been ordered, its efficiency and value being demonstrated beyond question.

We must have an automatic device to regulate the brake-shoe pressure according to the speed so as to avoid "skidding" of the wheels and consequent loss of efficiency, and all parts of the brake must be strengthened to withstand the increased force to be applied. For emergency stops we must have a sand jet operated simultaneously with the air brake. Devices to accomplish this are brought out for attachment to the locomotive; they should be perfected and attached to the cars as well.

Our next problem is to remove as far as possible every known danger from the path of our train, and guard against such as cannot be removed by the best known appliances. At way stations where passengers must cross the main tracks, overhead or underground passages should be provided, and measures adopted to compel their use. Facing switches should be removed except where they are an absolute necessity, and whenever allowed to exist they should be guarded by an interlocked or electric signal, or both. All sidings should have derailing switches at the fouling point, connected with the main track switch. Drawbridges, junctions, and all other points where the tracks are of necessity frequently broken and obstructed, should have a system of interlocking switches and signals, and the entire line should be covered by some system of block signals, a purpose to which the electric track circuit seems best adapted as covering the widest range of possible dangers, and being the least dependent on human agency for the faithful performance of its duty; in fact, I look for improvements in the application of electricity that will make it the railway watchman of the future.

All fixed signals should be uniform in form and meaning, and care should be taken not to multiply them needlessly, making it a study to remove or group danger points, whenever possible, rather than add to the number of signals. For night signals, electricity has proved itself far better and more reliable than the oil lamp, and should be used wherever available.

Operating in connection with every fixed signal which is to be used for a stop signal, we should have a device which will apply the brakes and bring our train to a stop whenever the signal indicates danger, independent of any action on the part of the engineman. Appliances of this kind are now being put to the test of actual service; and that they will prove a valuable addition to our safety appliances, either in their present or an improved form, I have no doubt.

It would now seem that with these improvements and additional safeguards our train might go on its way in safety; but we have yet to meet and overcome one of our worst dangers, and one that has never received the consideration that it merits. This danger lies in the freight train running, not on our track, but upon the track 7 ft. or less away. Be our roadway and tracks as substantial as the hills, our drawbridges, junctions, stations, sidings and crossings ever so well guarded, our block system of signals ever so complete, our locomotive and cars perfect in their construction and equipment, yet in the face of an obstruction thrown on our track by a mishap to the freight, it all goes for naught.

Whenever a fast passenger train meets and safely passes a freight train running on the opposite track, and this happens many times a day on most roads, it narrowly escapes disaster. Many frightful accidents have happened from this cause, and their number will increase with the increase of passenger and freight traffic, and the speed of trains, unless a remedy is applied; the remedy lies in one direction, and in one only; we must prevent the mishap to the freight train.

To do this we must raise the standard of our freight equipment; quality rather than price must govern the selection of material for its construction; all old or weak cars must be discarded, and the freight car made to carry its load with as much safety as does the passenger coach. The old-fashioned door, which easily slips from its fastenings, and often followed by a part of the contents of the car, falls to the opposite track or against the side of a passing train, has performed its mission, and must go—the sooner the better.

Breaking apart of the train, that fruitful source of trouble, and perhaps directly and indirectly responsible for more accidents and delays that any other one cause, must and can be stopped or reduced to a minimum. This may seem a bold statement, and I am aware that the coupler problem has not yet reached a point to warrant it; but I have yet to learn any good reason, financial or otherwise, why, pending the solving of the problem, freight cars should not be equipped with safety chains. Their application is simple and comparatively inexpensive, and I firmly believe that if applied to all cars they would more than repay their cost the first year in the saving of accidents and delays. If any gentleman present has ever tugged a draft chain through three feet of snow, from the caboose to the 20th car of the train, he will agree with me.

Stringent regulations must be adopted and enforced to prevent overloading and improper loading of cars, and better means provided for the securing of such freight as must be carried on open cars; in fact, wherever passenger and freight traffic are both conducted over the same or adjacent tracks, equal care for their safety must be exercised.

These, to my mind, are the principal physical and mechanical requirements necessary to higher speed. But with all these requirements met, we are still dependent for success and safety on the loyalty of the men engaged in the service, I use the term loyalty because it expresses all that men should be, and it should apply to all ranks from General Manager down. He who is loyal to the company he serves, and to himself, will do his best under any and all circumstances, and will have the interests of his employers at heart always.

More care should be exercised in the selection of men than has been hitherto. Applications for positions of responsibility on our roads, or from which promotions to positions of responsibility are made, should be in writing in a regular form, accompanied by references; such applications to be referred to a standing committee, composed of experienced officials from different departments, with a representative employee from the department to which the application was made. The applicant's general character could then be investigated, and, if found satisfactory, notice sent him to appear for examination, regular dates being fixed for the purpose. The committee, if satisfied of the man's fitness for the service, would forward a certificate to that effect to the proper head of the department, who would enter the application to be taken up in regular order as vacancies occurred. Examination should be made from time to time of employees in line of promotion.

Should such a plan be adopted, its advantages would be felt in every direction; the intemperate and vicious would be kept out of the service; those well-meaning, but lacking in natural fitness, would be saved from ultimate failure and disappointment, which, by the way, is often postponed at a frightful cost of life and property; accidents would be reduced to a minimum; strikes would be unheard of; with such material once enlisted and fairly treated, the tramp railroad man, the bane of the service, would disappear; and, not the least of all, a fearful load of individual responsibility would be lifted from individual shoulders.

What effect an increase of 25% in the speed of our express trains will have on the local traffic is an important consideration, and can only be determined by the volume and character of the traffic. In many cases it will mean an equal increase in the speed of local passenger trains at least; otherwise local trains would have to side-track and wait the passage of express trains; trains would soon become bunched, and a general demoralization of the train service would result.

The speed of these trains can be increased, but the cost of such increase must be considered as vital to the question at issue, and in this calculation the rapid rate at which the train resistance increases with increased speed, will cut an important figure. I do not know that the exact ratio of this increase has ever been determined, but the diagram given us by Mr. Worney is probably approximately correct. From this it appears that on a level track, at 40 miles an hour, the resistance is about double that at 25 miles an hour, and at 60 miles an hour it has again nearly doubled, being respectively 7, 13 and 25 lbs. per ton.

(Recent experiments seem to show that resistance at high speeds is not as great as has been generally supposed. See Eng. News, June 9, 1892. Ed.)

What is a reasonable speed must be determined by each railway manager for himself, and not by the public. The average traveler whirled along at 40 or 50 miles an hour has little idea of the conditions necessary to insure his safety, and when an accident does happen expressions of surprise are general; but the thinking railway man, although he may not express his feelings, is surprised that they happen so seldom. It is true that numerous American roads are safely running one or more daily trains at an exceptionally high speed; but these trains are operated under provisions which cannot be accorded to the general express traffic; and the wisdom of encouraging a public demand which we are not prepared to meet is questioned by many able railway managers.

The steady increase of traffic calls for improvement in system and appliances to enable us to maintain our present speed with safety. We should meet these requirements before making any attempt at an increase. I am alive to the fact that speed in all things is the order of the day, and I would not be counted as in the rear of the procession, but I do not want to see the dangerous experiment of higher speed without a proportionate advance in system and safety appliances.

THE ADVANTAGES OF SPIRAL PUNCHES.

Interesting experiments in punching steel plate with punches of various shapes were described before the Civil Engineers' Club, of Cleveland, recently by Mr. C. H. Benjamin, and are reported in the "Journal of the Association of Engineering Societies." The experiments indicated that an important gain might be made by the use of punches with a spiral face. The material used in the experiments was Otis steel boiler plate ¼-in. thick and 60,000 lbs. tensile strength. Besides the common flat punch, round and square, experiments were made with the center punch, having a small conical center, the double punch, made in two steps and the spiral punch. The dies were made with a clearance of .013 to .22 in. The average of several experiments showed that the ultimate resistance to punching a ¾ in. hole in the plate with either the round center, round flat or double flat punches was about 50,000 lbs. The average of the tests with a spiral punch of the same size was only 38,600 lbs. A more important advantage of the spiral punch is that it does the metal less injury. The plates after punching were pulled asunder in a Riehle testing machine, and the elastic limit, reduction of area and ultimate strength were compared with those of a plate having a drilled hole of the same size. The average effect of all the punches except the spiral punch on the metal was to increase by 5% its elastic limit, and decrease by 7.5% its ultimate strength and by 30% its contraction of area. The spiral punch reduced the ultimate strength only 3% and the reduction of area 20%.

The only difficulty found in using the spiral punch was that it developed some tendency to crowd to one side. It is proposed to obviate this by making the face a double spiral, that is, with two high points on opposite sides of the punch, which will center the resistance on the axis of the punch. The reason for the smaller resistance of the spiral punch is evident on a little thought. It makes a drawing or shearing cut around the circumference of the hole, while with the ordinary punch the resistance is concentrated at a single point of the stroke.

In a personal letter to this journal Mr. Benjamin states that he has already begun further experiments on punches and punching, and hopes to present more complete results at an early date.

COST OF LAYING PIPE SEWERS AT DALLAS, TEX.

Detailed figures regarding the cost of engineering work are rarely available to the public and are far too rarely put in a comprehensive form for the personal use of those engaged in designing and superintending such work. The accompanying figures regarding the cost of laying pipe sewers at Dallas, Tex., during the last four seasons will be of interest and value to many. They were compiled in the office of City Engineer D. A. Poyner, M. Am. Soc. C. E., by Mr. Frank E. Snyder, Assistant City Engineer.

The table includes work done under twenty or more contracts ranging from $20,000 down to $200 each. Mr. Snyder states that the total cost of the work was increased by the laying of a deep sub-main sewer and laterals of 15, 12 and 8-in. pipe.

The separate system of sewers is in use in Dallas, there now being about 26 miles in use. The largest sanitary sewer is of brick, 3 ft. in diameter. There are four miles of storm sewers, the largest of which is 9 ft. in diameter. All sewers are circular.

It will be seen from the table that the pipe formed 35.8 and the earth excavation and back filling 37.7% of the total cost of the sewers.

PERSONALS.

Mr. Poynor, City Engineer of Dallas, Tex., has tendered his resignation.

Col. C. J. Eldridge, civil and mining engineer, of Leadville, Col., died Nov. 5.

Mr. A. B. Hallock, architect, of Portland, Ore., died at Tillamook, Wash., Oct. 31. He was the first city surveyor of Portland.

Mr. James W. Johnson, City Engineer and Superintendent of Streets, Riverside, Cal., was married to Miss E. S. Chapman, on Oct. 6.

Mr. C. E. Loss, of Chicago, has been elected Vice-President of the Whiting, Hammond & East Chicago Street Ry. Co., with offices in the Pullman Building.

Mr. J. R. Nelson, of Denver, Col., is surveying the district between the headwaters of the North Platte and the Cache la Poudre rivers, for a project to divert the former into the latter stream by a tunnel through the Medicine Bow Range.

Mr. John A. Cole, of Chicago, has been engaged as Consulting Engineer, to report on plans for reconstructing the water-works at Evanston and Connersville, Ind., and St. Charles, Mo. He is also preparing plans and specifications for water-works and sewerage systems at Naperville, Ill.

Mr. Robert Moore and Mr. Julius Pitzman, of St. Louis, have been appointed engineers to make plans for the building of levees for the Chouteau, Nameoki & Venice drainage district, in Madison Co., Ill. The district comprises about 25,000 acres. The engineers named have concluded to make a careful stadia measurement of the entire district, and they want a few engineers of experience for this work.

NEW PUBLICATIONS.

GENERAL SPECIFICATIONS for Combination, Iron and Steel Railway Bridges.—By A. D. Ottewell, Consulting Engineer; single sheet, two pages. San Francisco: 1892. Price (each), 10 cts.

These specifications, which were originally got up by the author for his own practice on the Pacific coast, have been printed and placed on sale. They are claimed to embody all the results of the latest experiments and investigations, and especially to furnish a more scientific and simple method of computing alternating strains than has heretofore been published.

STATISTICS OF RAILWAYS IN THE UNITED STATES. Report to the Interstate Commerce Commission for the Year Ending June 30, 1890. Pub. Doc.; Washington, 1891. 8vo; cloth; pp. 983; map and diagrams.

We have already reviewed the advance sheets of the report proper of the Statistician at some length. In addition, the full report contains very complete detailed statistics of railway mileage and operations, and the financial statements of the several companies. The volume shows an increase of 417 pages in size over the report for 1889.

STATE BOARD OF HEALTH OF MAINE: Report for 1891. A. G. Young, M. D., Secretary. 8vo, cloth; pp. 399; 98 illustrations.

This report contains the results of 134 analyses of water made during the year in the laboratory of the board. Of the samples of water analyzed, 74 were from wells, 32 from springs, 18 from existing and 6 from proposed water supplies and 3 from other sources. About 300 pages of the report are taken up with a very exhaustive monograph on "School Hygiene and School Houses," by the Secretary of the Board. The lighting, heating, ventilating and draining of school buildings are among the subjects discussed and illustrated. Plans for the heating and ventilation of a number of school houses illustrated in the report were made by Prof. S. H. Woodbridge, of the Massachusetts Institute of Technology.

Amount and Cost of Pipe Sewers Laid in Dallas, Tex., from 1889 to 1892.

Size.	6-in. Length, ft.	6-in. Cost per ft.	8-in. Length, ft.	8-in. Cost per ft.	10-in. Length, ft.	10-in. Cost per ft.	12-in. Length, ft.	12-in. Cost per ft.	15-in. Length, ft.	15-in. Cost per ft.	18-in. Length, ft.	18-in. Cost per ft.	20-in. Length, ft.	20-in. Cost per ft.	24-in. Length, ft.	24-in. Cost per ft.	Total Amt.	Total Cost per ft.	Entire cost.	Per cent. of total cost.
		$		$	—Total length and cost of pipe of various sizes—			$		$		$		$		$		$	$	
Pipe	28,175	0.177	17,528	0.245	5.211	0.3615	4,606	0.456	2,418	0.75	1,738	0.90	1,490	1.20	6,926	1.76	68,394	0.4486	30,686	35.5%
	—"Cost of earth excavation and all back filling—																			
6 ft. deep	17,220	0.21	8,658	0.229	1,335	0.318	497	0.382	48	0.45	930	0.45	724	0.50	3,768	0.457	33,180	0.2638	8,754	10.3%
7 to 8 " "	6,652	0.319	3,633	0.337	1,936	0.4056	1,144	0.484	23	0.55	592	0.55	155	0.60	913	0.661	15,048	0.3804	5,725	6.7%
9 " 10 " "	3,363	0.415	2,252	0.501	593	0.530	852	0.557	13	0.70	227	0.60	186	0.70	608	0.879	8,094	0.5105	4,133	4.9%
11 " 12 " "	711	0.616	2,386	0.729	1,252	0.732	489	0.775	49	0.95	.....	.....	165	0.10	244	1.056	5,296	0.7476	3,959	4.7%
13 " 15 " "	3	1.20	435	1.164	84	0.750	267	0.936	184	1.45	.....	.....	140	1.20	626	1.500	1,739	1.2638	2,198	2.6%
16 " 18 " "	44	1.50	21	1.50	.....	.....	684	1.142	568	1.90	.....	.....	.....	.....	519	1.831	1,836	1.5840	2,909	3.4%
19 " 21 " "	.....	.....	14	2.75	.....	.....	.....	.....	728	2.75	.....	.....	.....	.....	.....	.....	742	2.7500	2,041	2.4%
22 " 25 " "	.....	.....	.....	.....	.....	.....	.....	.....	805	3.50	.....	.....	.....	.....	.....	.....	805	3.5000	2,818	3.3%
	—Miscellaneous items.—																			
Manholes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43	55.00	2,365	2.8%
Lampholes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	91	4.40	400	0.5%
*Rock excavation	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33,725	0.41	13,839	16
Embankment	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,180	0.34	741	0.9%
Re-paving	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,609	4.3%
Incidentals	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,492	1.7%
Total	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	$85,759	.....
Per cent. of total length pipe	41.5%	.....	26	.....	7.5%	.....	6.5%	.....	3.5%	.....	2.5%	....	2.5%	.....	10.5%	.....	.....	.....	.....	.....

* Rock excavated—per lineal foot each foot in depth.
** Earth excavation and all back filling 37.5% of total cost.

Mr. J. J. R. Croes will lecture Nov. 30 at the Rensselaer Polytechnic Institute, Troy, N. Y., on "Handling Passenger Traffic in Large Cities." Mr. Theodore Voorhees, General Superintendent of the New York Central R. R., will lecture there in December.

Mr. Chas. A. Allen, M. Am. Soc. C. E., until recently City Engineer of Worcester, Mass., has opened an office at 44 Front St., Worcester, where he will attend to general engineering work, and make specialties of sewerage, sewage disposal, water-works and water power, and the abolition of railway grade crossings.

Mr. C. R. Fitch, Superintendent of the Eastern Division of the New York, Lake Erie & Western R. R., has been appointed General Superintendent of that road, with headquarters in New York. Mr. M. W. Maguire, Superintendent of the Susquehanna Division, has been transferred to the Eastern Division, with office at Jersey City, N. J., and Mr. H. E. Gilpin, Superintendent of the Tioga Division, has been appointed Superintendent of the Western Division.

Mr. J. J. R. Croes has been engaged in investigating the condition, methods of construction, cost, and requirements for the future, of the water-works at Middleborough, Ky., on which a large amount of money is said to have been expended without much apparent result as yet. This investigation was undertaken at the request of the English capitalists who have supplied the funds for the development of the valuable coal and iron properties at this location.

TRADE PUBLICATIONS.

STEEL CASTINGS.—Congdon Brake Shoe Co., Chicago, Ill.; 12mo, pp. 4.

This little pamphlet gives some notes of the new steel plant for the manufacture of open-hearth and crucible steel castings, noted in another column. Various forms of brake shoes for locomotives and cars are manufactured by this company.

SOCIETY PROCEEDINGS.

INSTITUTION OF MECHANICAL ENGINEERS (From Our London Correspondent).—The ordinary general meeting was held in London Oct. 26 and 27. There were only the following two papers on the list: "Second Report of the Research Committee on the Value of the Steam Jacket," by Henry Davey, chairman; and "Experiments on the Arrangement of the Surface of a Screw Propeller," by William George Walker, of Bristol.

The steam jacket committee is one of the many research committees which have been formed by the

Institution to the great advantage generally of mechanical science. The committee whose work is under consideration, however, appears to be one of the weakest yet formed, at least its work is among the least satisfactory. The report has been a very long time in making its appearance and now it has come it is not worth a very great deal. It is simply a record of certain experiments which may be added to hundreds of others that have preceded them without loss or gain; excepting perhaps that the student has just so much more matter to wade through and reject. The exception to these statements is the work which is recorded of Mr. Bryan Donkin. This gentleman has really tried to tell us something we did not know before, namely the temperature of the walls of the cylinder at various distances from the surfaces. It is not his own fault that Mr. Donkin's apparatus is somewhat coarse for the purpose. The diameter of the thermometers he used is not given, but probably they could hardly have been less than ¼-in., and if this were the case, it is not much good, ostensibly working to .06 in. The report commences with the recital of previous experiments made to test the value of the steam jacket. The first trial quoted was made by Signor P. Guzzi, of Milan, on a single cylinder condensing engine. No experiments were made without steam in the jacket, but in one case the jacket pressure was 48 lbs., and in another the jacket pressure was 187 lbs., the boiler pressure being 56 lbs., with other factors arranged so as to give a comparable result, the saving in feed water due to the higher jacket pressure was 16.8%. It is not quite clear, however, whether the steam condenser in the jacket was debited in the case of the higher pressure. With a single cylinder Corliss engine working at about 60 lbs. with five expansions, and about 56 revolutions, the saving due to the jacket was 12.3%. This experiment was made by Professor Doerfel at Prague. A pair of compound jet-condensing beam pumping engines tested by Mr. F. Ollgaard at Copenhagen, in 1890, boiler pressure about 51 lbs., number of expansions about 14, and 19 revolutions without the jacket and 24 with it in use, the saving in feed water was 18.6%. With a triple expansion engine at Owens College, tested by Prof. Osborne Reynolds, working at a boiler pressure of about 190 lbs., with 15 expansions without jacket and 26.5 with, the revolutions being about 300, the saving in feed due to the use of the jacket was 17.4%. This engine was jacketed all over, there being 15 jackets to the three cylinders.

Coming now to the experiments of the committee, the first was made on a pumping engine by Mr. J. G. Mair-Rumley, who is a well known authority on the subject. His trials were somewhat marred by uncertainty caused by priming, and the drain water from the jacket not being completely measured. With a steam pressure of about 50 lbs., and about 15 revolutions per minute, he got an economy of feed of 8.6%. The next experiment was on a water-works pumping engine of the triple expansion marine type. The boiler pressure here was 130 lbs., the number of expansions 22 and 30, the revolutions per minute 23, and the saving in steam consumption 10.3%. A case in which a very great advantage for the jacket was recorded was that of a compound engine at Woolwich Arsenal. The boiler pressure was 50 lbs., the number of expansions 9.4 without the jacket and 12.6 with. The revolutions per minute were 57 and 63, and the saving in feed 19%. Trials were made some time ago with an engine in Woolwich Arsenal, and if this is the same engine, the figure of economy due to jacketing is not surprising, as the engine was as ill-designed as it well could have been. Next come a series of experiments made by Professor Unwin upon the experimental compound engine at the Central Institution at South Kensington. These experiments take the form of the usual laboratory tests made for the instruction of students. The engine was first run as a simple engine, using the low pressure cylinder only. Under these conditions the percentage of gain in the weight of steam was 17%. With conditions comparable, the percentage of gain was 7.3% due to jackets when the engines were running compound. The feed water per I. HP. per hour was as follows: Single cylinder, unjacketed, 32.14 lbs., jacketed, 26.69 lbs.; compound, unjacketed, 21.06 lbs., jacketed, 19.52 lbs.

Mr. Bryan Donkin's experiments were made at his works on a small engine with a single sylinder 6×8 ins. These are the experiments in which an effort was made to take the temperature of the cylinder walls. These experiments are of a varied and voluminous nature, and they are yet incomplete, Mr. Donkin proposing to carry them to a further issue. With a mean temperature of steam in the jacket space of 298° F. the mean temperature of the cylinder walls was 8° lower; while at 0.06 in. from this piston the mean temperature was 284° F. The initial pressure in the cylinder was 207 lbs, and the terminal pressure 223 lbs. This was with 3.75 expansions. It will be seen therefore that there was a good balance of heat in the cylinder walls close to the inner surface at the end of the stroke, and if this can be extracted with sufficient rapidity and absorbed by the watery vapor or globules of water in the cylinder it is easy to understand that the jacket would be effective.

The above are bare outlines of the data presented by the committee. They had decided not to express anything like opinions on the facts they presented and therefore the report is very meager. Another report however is to come, and it is to be hoped that the committee will pluck up sufficient courage to formulate its ideas and opinions on the subject.

The discussion which followed was not very instructive. Mr. Morrison, of Hartlepool, explained how he had arranged to provide for the circulation of steam in jackets by means of guide plates. The want of circulation and presence of air is probably the cause of the failure of a large number of steam jackets to give good results. The cimmittee in its report advises the placing of an air cock on the top of a steam jacket, in order to draw off air.

The paper on the screw propeller does not call for much notice. The screw propeller is a very big subject. It requires years of systematic experiment and research to enable one to make any substantial addition to the accumulated knowledge and to work out a scientific system embracing two or three factors, is a task which would spread over a life-time. Mr. E. D. Froude, in this country, seems to have devoted himself to this task, and any small nibblings at corners, such as the paper in question appears to be, are not likely to do much good.

OREGON ACADEMY OF SCIENCES.—The winter session of the Oregon Academy of Sciences (formerly the Science Club of Portland), of Portland, Ore., has been commenced. Among the subjects of lectures are the following: Dec. 12, "Formation of the Earth's Crust"; Jan. 9, "The Succession of Planets," Prof. H. N. Bolander; Feb. 13, "Origin and Distribution of Animal Life," Prof. J. L. Washburn; March 13, "The Advent of Man," Dr. H. D'Arcy Power; April 10, "The Development of Mind," Prof. J. Burnham; May 8, "The Growth of Civil Institutions," Prof. F. Young.

B. R. Baumgardt, Secy.

BROOKLYN INSTITUTE.—At the meeting of the Engineering Section on Nov. 14, Mr. Chas. E. Emery, in the chair, Mr. E. P. North, M. Am. Soc. C. E., read an interesting paper on "Roads, Their Influence on National Development and Power." Beginning with ancient history, he showed the development of nations and their roads, and pointed out the importance of this means of transportation. He presented numerous statistics comparing the amount of traffic on, and the cost of transportation by, railways, canals and highways in this country, and urged the advisability of providing as good roads as possible with local materials and then gradually improving them as the traffic increases. In the discussion reference was made to the economic advantages of good roads. A vote of thanks was tendered to Mr. North for his very interesting and valuable paper.

LIVERPOOL ENGINEERING SOCIETY. —At the meeting on Oct. 26, Mr. Robert E. Johnston, President, delivered his inaugural address, selecting as his subject the development of railways and the various improvements in their construction and working which have taken place since their introduction. After briefly describing the means of locomotion at the beginning of the century, and the opening of the Liverpool & Manchester Railway, he stated that at the present time the length of the railways of the United Kingdom amounted to no less than 20,073 miles, representing a capital outlay of $4,487,360,000. The total receipts for the year 1890 were approximately $382,500,000, and the working expenses about $207,500,000, leaving a balance of about $175,000,000 as the profit of one year's working, representing an average dividend of about 3.9% per annum for the total capital expended. He then discussed in detail the various improvements which have been effected in the construction of railways, in the design of bridges, tunnels, track, and rolling stock, and in doing this, dealt with the construction of the Severn and Mersey river tunnels. He pointed out that the practical outcome of the labors of the managers and engineers of the railways in their endeavors to render railway traveling as safe as possible, had been to reduce the number of fatal accidents in 1890 to 1 in every 163,500,000 passengers carried. In conclusion, he gave a description of the means adopted in constructing railways with exceptionally steep grades in Switzerland.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting Nov. 2, the paper by William L. Saunders, on "Electric Rock Blasting; The American Method," was read by the secretary, and discussed, as noted last week. Mr. J. Spencer Miller called attention to the low cost at which Mr. Edison claims to be blasting and moving iron ore at the New Jersey & Pennsylvania Concentrating Works, at Ogden, N. J. An interesting piece of information has been worked out there, showing the cost of wear and tear and interest on plant to amount to one cent per ton handled. Mr. Whinery gave experience of 12 years ago when in government employ, in blasting rock, both under water and in quarries. A very accurate account of all expenses was kept, and all blasting was done by electricity. In a quarry of solid limestone with a face 50 ft. high, and ledges 6 to 12 ft. thick, the stone being moved from the level of the bottom, a distance of about 60 ft., to flatboats, the actual cost of riprap stone for labor, tools and materials was 28.4 cts. per cu. yd., as measured in the solid rock by cross-sectioning. This was the average on three months' work. Large masses were moved by derricks. Water tamping was found to be insufficient in 18 ins. depth of water. Sharp sand in water did not give a good result. Plaster of Paris succeeded, but was expensive. Pebbles screened to obtain those about the size of grains of corn were best. He advocated the use of blast testing machines and described a simple one he used successfully. Every fuse should be tested, and the result will be a large saving of time. He further stated that leading wires for moderate distances need not be insulated, and four exploders can be fired with a naked wire passing through 100 ft. of water.

Much of the material in the use of high explosives is wasted. It is almost impossible to get foremen to use only a sufficient quantity of dynamite. The desired result was reached in this case by a rod of wood, one side of which was graduated to feet and tenths, and the other side to inches of dynamite to be used, the latter being obtained by computation. This was used by laying it on the rock, in the direction of the line of least resistance, and employing the amount of dynamite indicated on the rod for the distance measured. A saving of 50% was effected by this means.

Mr. A. M. C. Parker stated that in blasting at 125th St., to get a uniform depth of 12 ft. at low tide, or 17 ft. at high tide, he had fired seven holes with no attention to insulation of hte wires. Rack-a-rock was used, and it oftens happens that the exploders are fired without firing the cartridge; this is, however, believed never to occur with dynamite. In this depth of water, there has been no trouble about tamping. Mr. E. P. North mentioned a case of chilled dynamite cartridge 6 ft. under water which was not fired by an 8-grain exploder, the latter being thrown out only. Two such exploders fired the cartridge.

Written discussions on this paper, and also on the paper by Mr. Saubye on "A Cheap Dam Across the Roanoke River, at Salem, Va."; may be sent in until Dec. 15. Copies of these papers will be sent on request to those wishing to discuss them.

COMING TECHNICAL MEETINGS.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 18. 201 Washington Building.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 19, 1122 Girard St., Secy., L. F. Rondinella.
SWEDISH ENGINEERS' CLUB.
Nov. 19, Secy., P. Valentine, At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago; Secy., John Ericson.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 22, "Water Purification, Secy., R. H. Clark, Pittsburg, Pa.
CENTRAL RAILWAY CLUB.
Nov. 23, "Defects on Freight Cars." Secy., S. W. Spear, E. Buffalo, N. Y., Iron Works.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Dec. 2, Secy., E. K. Smoot, 806 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 2, Secy., O. Von Geldern, 719 Market St., San Francisco.
NORTHWEST RAILROAD CLUB.
Dec. 3, Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 3, Secy., F. D. Jones, Helena.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 5, Secy., C. L. Annan, City Engineer's Office.
NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 6. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Dec. 6, Secy., Chas. S. Howe, Case School.
DENVER SOCIETY OF ENGINEERS AND ARCHITECTS.
Dec. 6, Secy., Geo. H. Angell, 36 Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Dec. 6, Secy., Parker N. Black, Capitol Block.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Dec. 6, Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Dec. 7, Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 7, Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Dec. 7, Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 8, Secy., F. W. Cappelen, 1628 Hennepin Ave.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE
Dec. 8, Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 8, Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 9, Secy., D. W. Meeker, St. Paul.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 9, Secy., C. H. McLeod, Montreal, P. Q.
WISCONSIN POLYTECHNIC SOCIETY.
Dec. 13, Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
Dec. 13, Secy., Waterman Stone, Baird Building.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Dec. 14, Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Dec. 14, "High Speed for Trains," Secy., F. M. Curtis, O. C. R. R., Boston.
NEW YORK RAILROAD CLUB.
Dec. 15, Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Dec. 15, Secy., J. F. Wilson, 24 W. 4th St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Dec 15, Secy., F. A. Charpiot, Macon, Ga.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
Dec. 15, Secy., C. F. Franson, Portland Block.
WESTERN RAILWAY CLUB.
Dec. 20, Rookery Building, Chicago. Secy., W. R. Maxtell.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 21, Secy., S. E. Tinkham, 36 Broomfield St.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXVIII. THURSDAY, NOVEMBER 17, 1892.

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GEO. H. FROST.....BUSINESS MANAGER

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How steep is a grade of 100%? Probably very many engineers, if they answered this question off-hand, would reply, "vertical." Or if asked what is the grade of a vertical rise, they would reply, "100%." But when it is remembered that the per cent. of a grade expresses the ratio between the horizontal distance and the vertical rise, it is seen at once that a 100% grade in which this ratio is 1, corresponds to an inclination of 45°. The grade per cent. of a vertical line is evidently infinity, the quantity expressing the horizontal distance becoming zero.

As an example of how easily the above error is made, we notice in a recent issue of one of our best edited technical contemporaries, that the editor in an editorial note and one of the most prominent and able members of the Institute of Electrical Engineers, in a contributed article both make this mistake.

The prospects are that another tunnel may be constructed at an early date through the Palisades of the Hudson River, as briefly noted in another column. Owing to the quietness and secrecy with which the projectors have carried on the preliminary work thus far, the project has not attracted the attention which its magnitude as an engineering work demands. Even now it is mostly a matter of speculation as to who is back of the enterprise. The most persistent rumor has been that it is a Canadian Pacific scheme and a part of a proposed line to give that company an independent entrance into New York city. The facts, however, do not bear out the rumor and the probabilities are still more against it. A more probable theory is that the Pennsylvania R. R. Co. is the principal party interested. For some time vague rumors have been in circulation that the Pennsylvania R. R. Co. was financially interested in the New York, Susquehanna & Western R. R., even to the extent of having a controlling interest in that property. The recent quite extensive improvements of the New York, Susquehanna & Western lines and the construction of a connecting line from Wilkes Barre to Stroudsburg, Pa., are quoted as tending to show the correctness of these rumors. Admitting this to be true the theory that the Pennsylvania R. R. Co. is interested in the construction of the tunnel has a considerable element of probability. The large tract of land along the Hudson River water front owned by the corporation under whose name the tunnel is projected, is well adapted for railway purposes and would undoubtedly prove a valuable addition in some respects to the Pennsylvania Co.'s terminals connecting with New York city. At the same time it is hardly clear how the advantages to be gained by these additional terminals are sufficient to warrant the expenditure which the construction of the proposed tunnel and its connections will entail.

If the comparative vote in the last election may be trusted as giving a fair indication, the population of Chicago is very rapidly crowding up upon New York, and has already left Brooklyn far behind. In round figures, the total vote cast in the three cities was as follows:

	New York.	Chicago.	Brooklyn.
Vote	283,000	248,000	173,000
Ratio	1.141	1.00	0.697

Calling the population of Chicago what is now claimed for it, 1,500,000, we should have the following population indicated for 1892, as compared with the census population of 1890:

	New York.	Chicago.	Brooklyn.
1892, as per vote	1,711,500	1,500,000	1,035,500
1890, as per census	1,515,301	1,099,850	806,343
Apparent gain	196,199	400,150	229,157

This seems to give a fair rate of increase for Brooklyn; in fact, an enormous increase; but the population indicated for New York is quite inadmissibly small, as it was claimed with good reason that the census of New York was far too small, and that the population was about 1,711,000 even in 1890. The only possible way of explaining this contrast without admitting that Chicago is gaining rapidly on New York is to assume that a much smaller per cent. of the population were actual voters than in Chicago. We see small reason for this assumption, however. New York city was known to be overwhelmingly Democratic, but the state as a whole was generally regarded as close and pivotal, whereas Illinois was generally regarded, as surely Republican by a large majority. These conditions were well adapted to induce a certain negligence in voters of both parties in Chicago and to encourage every possible voter to go to the polls in New York, for there is now no reason for doubt that Tammany fully supported the Democratic national ticket, and swung every vote it could into line for it. On the other hand, the registration in New York was undoubtedly 10,000 to 20,000 less than was expected, indicating some apathy of individuals, while Chicago is perhaps gaining a few thousand votes temporarily from workers on the great Exposition. But making all reasonable allowance for this, and for the greater proportion of women, children and aged males in Eastern cities, we do not see how the ratio of New York proper to Chicago can be considered higher than 1.25 to 1.00, if so high, making the populations stand in the ratio of 1,875,000 to 1,500,000. If so, nothing but the annexation of Brooklyn can keep New York long at the head of our list of cities.

The indefatigable efforts of Mr. A. A. Pope, of Boston, Mass., on behalf of better country roads we have had occasion many times to notice and commend. We are most reluctant to put a stone of any kind in his path, wherever his path may lead for the time being, knowing well with what zeal he is laboring for a great and needed reform. But when zeal outruns discretion, as it is very apt to do in such a case, it is in the end better for the cause to check it at once, by declining to adhere to any proposition which is sure to fail, especially if it is one which also ought to fail. That zeal outruns discretion in the following petition, which we have just received from Mr. Pope with a request to sign and editorially endorse it, we think is clear:

To the Honorable Senate and House of Representatives in Congress assembled: We, the undersigned citizens of the United States, hereby most respectfully petition that there be founded in the city of Washington, in the District of Columbia, a Road Department, similar to the Agricultural Department, for the purpose of promoting knowledge in the art of constructing and maintaining roads; and we ask that in such department provision be made for teaching students so that they may become skilled road engineers.

In connection with this Road Department we request that there be established a permanent exhibit, in which shall be shown sections of roads, illustrating various methods of construction, and also the best road materials and machinery.

We further petition that Congress appropriate funds sufficient to erect a building at the World's Columbian Exposition for the purpose of comprehensive load exhibit.

That another Department and Cabinet officer should be added to our machinery of government solely to create interest in the work of improving country roads, seems to us a proposition which is not only sure to fail but palpably ought to fail. The very nature of the movement, if it is a hopeful one, shows that it is only temporary. Our roads once in reasonably good condition, like the roads throughout Europe, all necessity for public interference would be over; because the whole theory of the movement is that it is an educational one, that the public sins only from ignorance and against its own interests. The official Departments, however, are only for transacting routine and continually recurring public business. Every argument which favors the creation of such a department merely to hasten a reform of public customs in respect to roads would also apply, and with equal or greater force, in favor of creating a Department of Temperance, or a Department of Morality, or a Department of Sanitary Plumbing; and so on through quite a long list of possible reformatory "Departments."

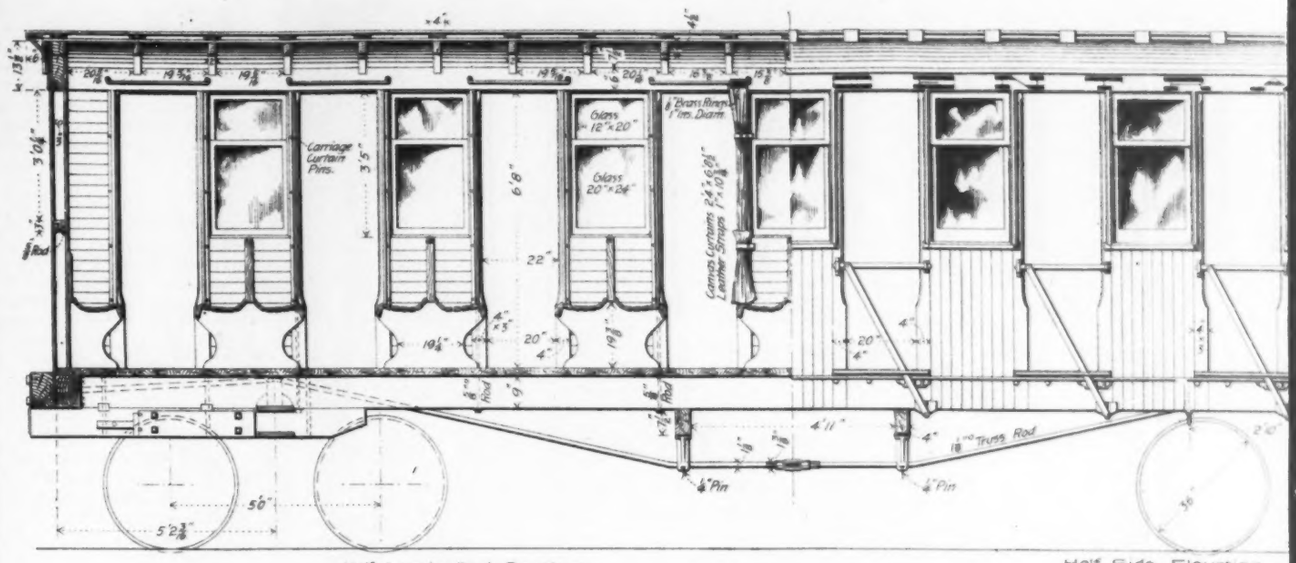
Had Mr. Pope confined his petition to one for a Department of Public Works, in which a Bureau of Public Highways should be an important feature, he would have been standing on solid ground where we should have been glad to stand with him, for there is a real need for such a department, and a Bureau of Public Highways would have been very appropriate within it. For the amount of governmental public works which are now carried on under four or five different departments, and especially under the War, Treasury and Navy Departments, is such in its nature and magnitude as to demand a separate department for it. A bureau in such a department may be established or discontinued for any temporary or permanent purpose, as convenience serves, without affecting the framework of the government, and hence might very appropriately take up the road question on the only side of it with which the general government has any proper concern, the collection and dissemination of facts in regard to it, and the creation of public sentiment. Had he urged this Mr. Pope would have had the satisfaction of feeling that he was not only aiding the cause which for the time being he has most at heart, but also aiding a reform much needed for other reasons, on behalf of which he would have a great mass of already existing public sentiment to aid him. By thinking of his own end only, and making extravagant claims for that, we fear he is neither aiding his own cause nor any other.

An exhaustive report on the tin deposits in the Black Hills owned by the Harney Peak Mining Co., made by Capt. Josiah Thomas, Superintendent of the famous Dolcoath tin mine in Cornwall, has just been made public. Capt. Thomas' report fully confirms the opinion expressed by Mr. Stephen H. Emmens, in a paper published in our issue of Sept. 1, that notwithstanding the great show of tin ore in various parts of the Black Hills region, there are grave doubts as to whether any considerable body of ore exists or whether any of the mines can be worked at a profit. In view of the extravagant claims concerning American tin mines which have filled the daily papers, as well as many technical journals, during the past few years, this result from the careful examination of acknowledged experts is decidedly interesting. We shall publish next week a paper by Mr. Emmens, giving the gist of Capt. Thomas' conclusions, with some very interesting and important data concerning other prospective tin deposits in the United States.

The value not only to this country but to the world at large of the discovery of new and rich deposits of tin ore would be very great, for the increase in production of the metal has no more than kept pace with the increase in demand, as is shown by the following table, giving average prices of tin in the London market since the beginning of the century:

Year.	1800-'20	'21-'40	'41-'60	'61	'71	'80	'88	'91
Cts. per lb.	16.6	15.3	23.3	26.6	26.7	19.8	25.5	19.8

Especially within the past few years has the consumption of tin shown an enormous growth and this is likely to continue for a long time to come unless the growth in demand should cause a marked increase in price. Tin and gold are about the only two metals which have not fallen heavily



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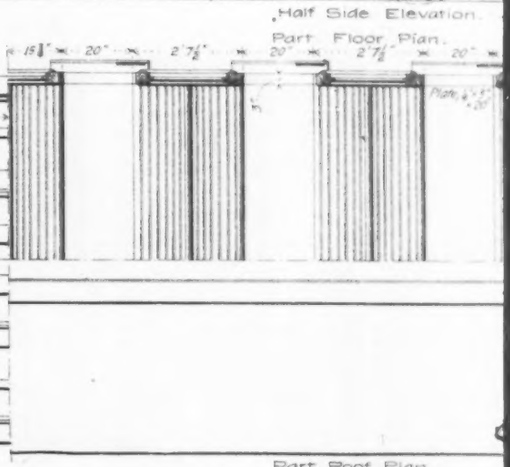
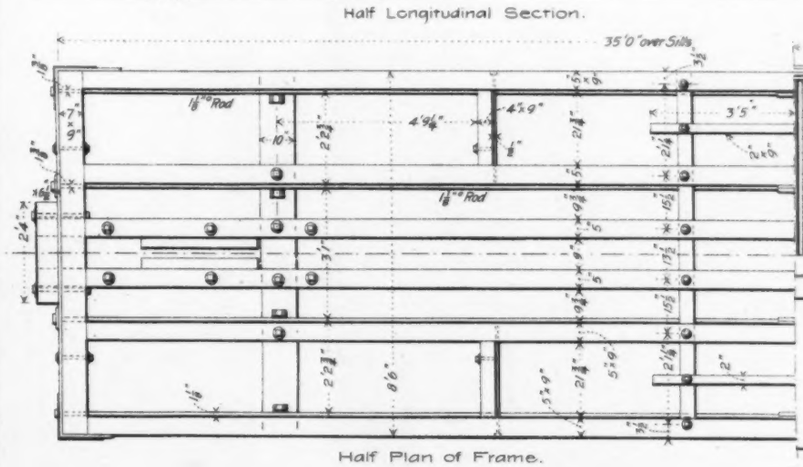
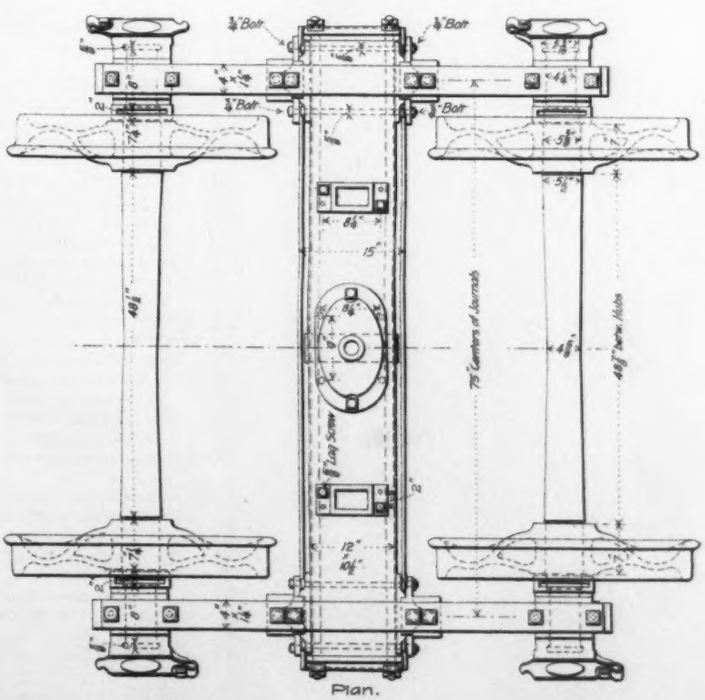




Half Plan of Frame.



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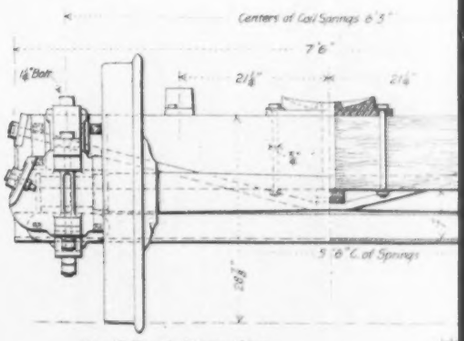

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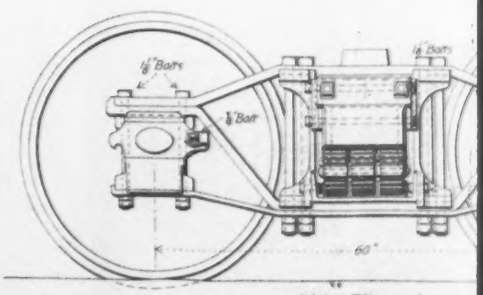
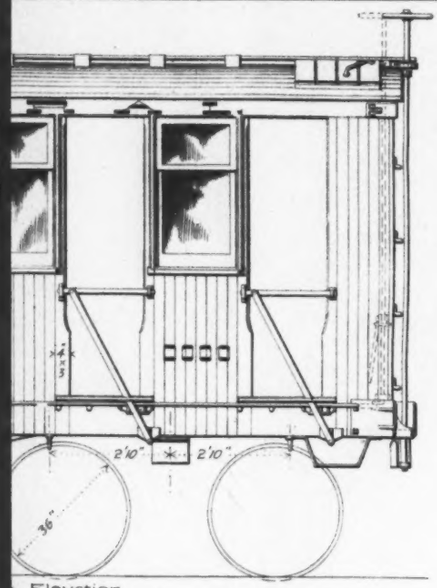


Side Elevation.

STANDARD TRUCK FOR TENDERS



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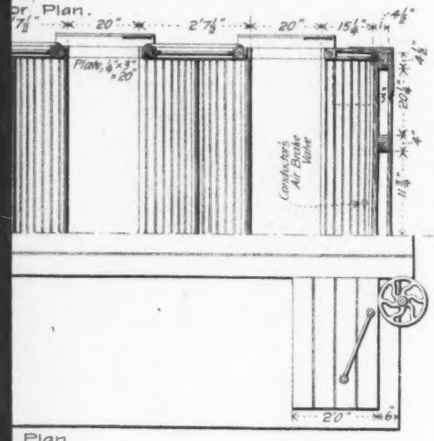

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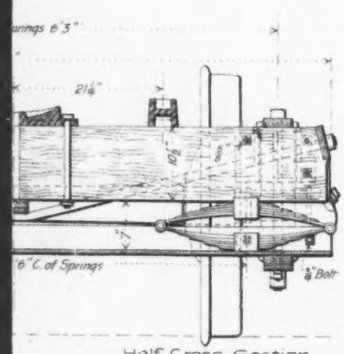
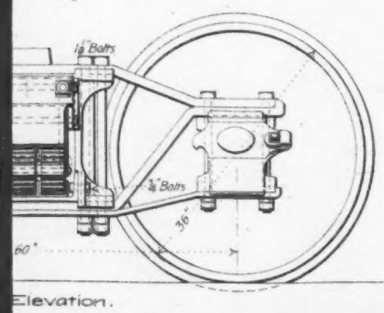


Half Cross Section through Bolster.



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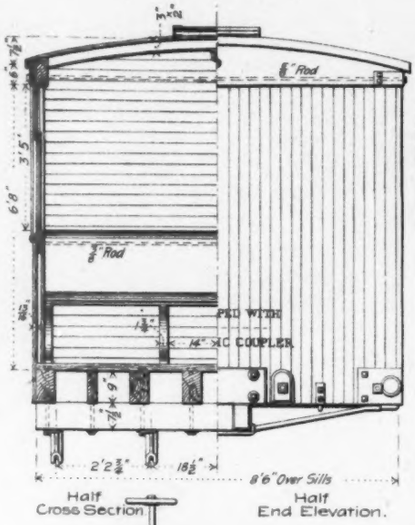
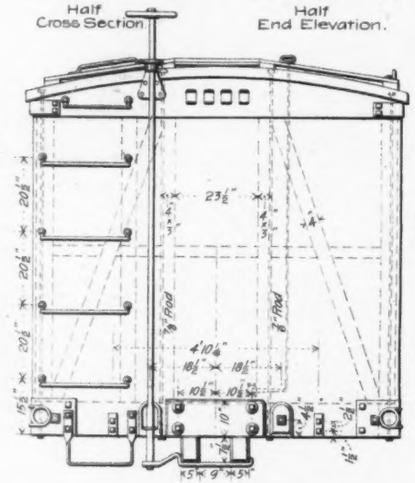
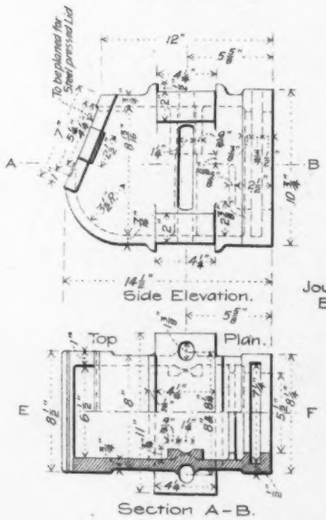


Half Cross Section

Half End Elevation.



End Elevation.



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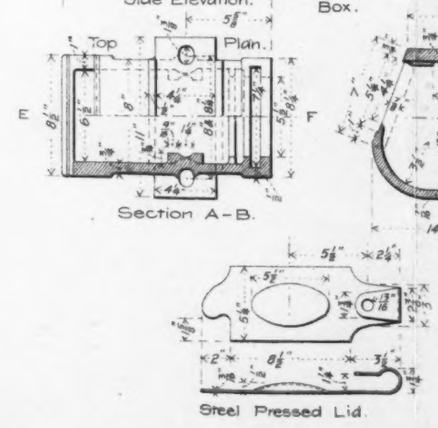
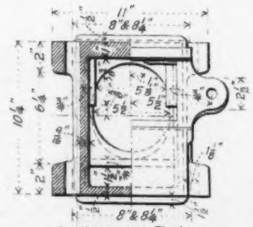
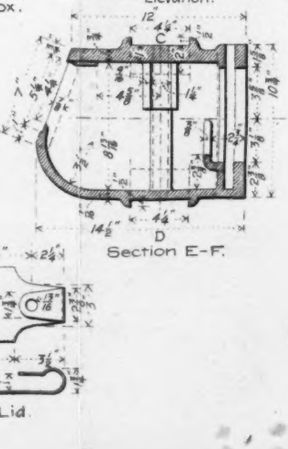


Steel Pressed Lid.



Journal Box.



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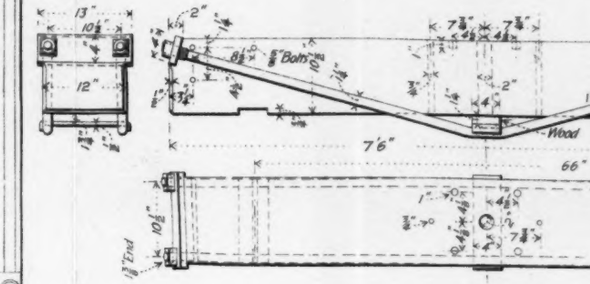
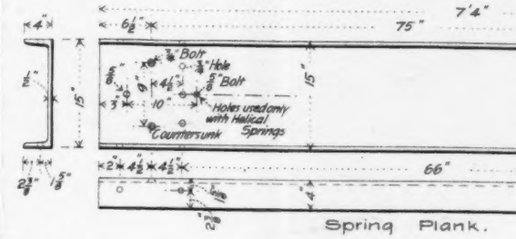
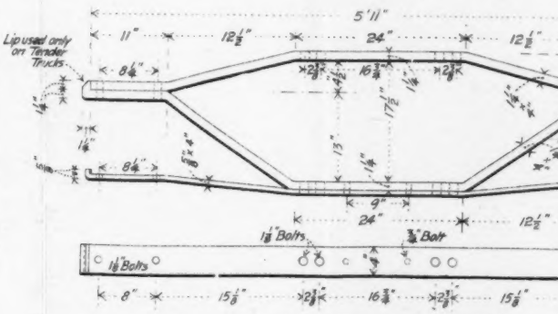


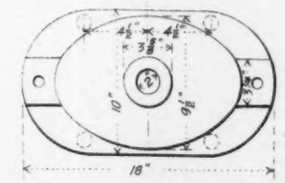
Bolster.

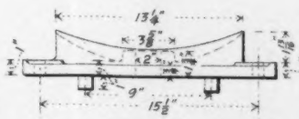


Spring Plank.



Diamond Truck Frame.





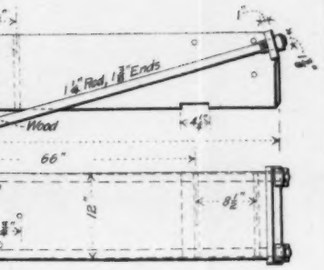
SPECIAL PASSENGE

WORLD'S COLUMBIAN

ILLINOIS CENTR

Henry Schlacks, Superintend

OR TENDERS AND FREIGHT CARS OF 60,000 LBS. CAPACITY.



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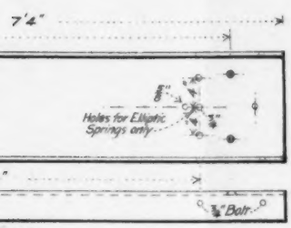

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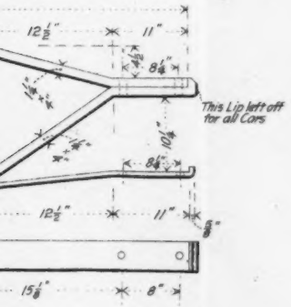

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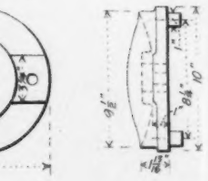
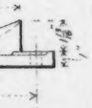


Center Plate.



SSENGER CAR FOR
UMBIAN EXPOSITION;
CENTRAL R. R.
perintendent of Machinery.

CHAS. HART & SONS, LITH, 30 VESEY ST., N. Y.

in "exchangeable value" in the last five decades in the face of enormous increase of demand, owing to enlargement of supply and improved metallurgical processes. For these reasons at least everyone will welcome the discovery and exploitation of really valuable deposits of tin ore in this country; but the stockjobbing and chicanery which has accompanied the prospecting of the Black Hills tin deposits has been of itself sufficient to make their actual value very doubtful.

THE SAFE LOAD FOR BEARING PILES.

In our issue of Dec. 29, 1888, we published an article on the subject of "Formulas for the Safe Load of Bearing Piles," in which a simple formula for the safe load of piles was proposed which has since met with wide and increasing acceptance; so that we might fairly say, perhaps, that it is now one of the most generally approved for practical use, if not the most approved among those who know of it. We claimed for it then that it would be found more trustworthy than any one of 16 different formulas which were given in it, quoted from Mr. Hering's admirable monograph on "Bearing Piles."* The experience and opinions of others have since confirmed our belief that this claim was well founded, and especially a recent paper by Mr. J. Foster Crowell before the American Society of Civil Engineers and the valuable discussion which followed it. The substance of both paper and discussion has been running through this journal for several issues, the last of it appearing in our next issue.

We do not propose now to enter upon any detailed discussion of this discussion; it would occupy too much space, and would only be repeating in other words what has been said with sufficient fulness, perhaps, in the discussions themselves. It will be obvious to every one who reads the discussions, however, that they have added certain facts to our knowledge of pile-driving, and suggested and collated still more facts or well founded opinions. What we now propose to do, therefore, is to combine and codify in the form of suggested "Rules of Practice for Pile Driving" all those facts which seem to us to be sufficiently well determined to be incorporated in such a code, adding in a following article certain explanatory notes and tabulations by way of comment. The following (which we offer subject to revision for the acceptance of engineers) would be our suggested code of

RULES OF PRACTICE FOR PILE-DRIVING AND SAFE LOAD OF PILES.

A: Methods of Driving Piles.

Six methods of driving piles are in established use, which in order of frequency of use are as follows:

1. By the ordinary pile driving, in which a hammer weighing 2,000 to 3,000 lbs. or more is dropped 20 to 30 ft. or more, falling free, with an interval of several seconds (5 to 20) between blows.

2. The same as 1, with the important exceptions that (a) the hammer does not fall free, but is retarded by the rope and revolving drum, and (b) the blows succeed each other somewhat more quickly. (This method is an uncertain and often deliberately deceptive one, but properly used is legitimate as well as convenient.)

3. By the water jet, in which a stream of water under pressure is ejected at or near to the point of a pile and rises thence along its sides, removing most of the side and end resistance, so that the pile sinks rapidly by its own weight, with or without some extra pressure added. This method is suitable only for sandy or other fine soil, but in such soils is often very efficacious when no other is possible.

4. By direct pressure of an insistant weight. This method is applicable to only very wet soils (practically saturated with water) of a muddy or very fine silty nature, but in such soils is often the only effective way of driving.

5. By the Nasmyth or other like steam pile-driver, in which somewhat heavier hammers (usually 3,000 to 5,000 lbs.) falling through much shorter falls (usually about 3 ft.); strike very much quicker blows (usually more than 60 per minute), but otherwise the same in principle as Method 1.

6. By gunpowder pile drivers, in which each blow is a double one, the first caused by the fall of the hammer after the last explosion, and the second, (following close upon the first, so that there is no intermission in the movement of the pile, but still distinct) by the reaction of the explosion which throws the hammer upward.

B. Bearing Power of Piles driven by Method 1.

7. The maximum or ultimate bearing power, which is a CERTAINLY UNSAFE load, in the sense that experience shows that piles will rarely bear this load (or any close approach to it) for any length of time without settling, is given by the formula:

$$M = \frac{12\,wh}{s+1}, \text{ in which}$$

M = the maximum or ultimate bearing power by any unit of weight.
w = the weight of hammer in the same unit.
h = the fall of hammer in feet, as below defined and limited.
s = the set of pile under last blow, inches, as below defined and limited, and,
1 = a constant which is made necessary by the fact that there is an extra initial resistance in getting a pile under way, and is intended to give the nearest feasible equivalent for the effect of that extra resistance in modifying the mean resistance to penetration. With individual piles it may or may not be a little more or less.

8. The safe or working load for piles, i. e., the load which it is CERTAINLY SAFE to place upon a pile under all conditions, except as below defined and limited, is shown by experience to be not over one-sixth of the above ultimate load, i. e.:

$$\text{Safe load} = \frac{2\,wh}{s+1} = \frac{M}{6}$$

in which the symbols have the same values as in the prior formula, the application of both of them being subject to the following limiting conditions:

9. As to w: The effective weight of the hammer is decreased about 1% by wind resistance, and perhaps ½% by guide friction, even when the guides are truely vertical and in good order. When pile and guides are inclined the effective weight is decreased (1) to h cos. I (in which I = the angle of inclination from the vertical) and (2) by the guide friction caused by the force w sin I pressing the hammer against the guides. With vertical guides this force is theoretically zero.

10. As to h: The full fall must only be counted (1) when there is no sensible bounce after the blow, and (2) when the head of the pile is in good condition. Bouncing in effect divides a single blow into two weaker ones, the energy of the first blow being diminished by an amount of fall equal to the height of the bounce, even if pile and hammer be assumed to be perfectly elastic. As neither is perfectly elastic, at least twice the height of the bounce should be deducted from h to determine its true value for use in the formula.

11. Condition of head: According to the best existing information a broomed head will destroy from half to three-quarters of the effect of a blow, even if the brooming be only a half-inch to an inch deep. No formula can be safely applied if the last blows be given with the head in such condition; but the remedy is to adze off or saw off the heads before giving the last blows, at least for a few sample piles, and if a very considerable difference is observed, then for all of them, if it is desired to determine and utilize their full bearing power.

12. As to s: The proper value can only be determined by taking the mean of the sets for a number of blows, nor then unless:

(a). The penetration has been at a reasonably uniform or uniformly decreasing rate, and

(b). There is reasonable assurance that the penetration would continue uniform if driven several feet further (which may be known from test piles driven to an extra depth or from general knowledge or evidence as to the nature of the soil, as that it is all sand, gravel or alluvial deposit). Also—

(c). The head must be in good condition as per par. 11; and also:

(d). The penetration must be at a reasonably quick as well as uniform rate, not less than ¼-in. for a 3,000-lb. hammer falling 30 ft. Any smaller penetrations under such a blow should be assumed to be due to mashing of the point and neglected, and any penetration of less than ½ in. is to be looked on with grave suspicion, and disregarded unless it has been uniform for many blows. With soft wood piles any penetrations of less than 1 in. under such a blow is likely to involve destructive strains within the pile, as per par. 14, 15, below, and hence should be disregarded in computing bearing power.

13. As to interval of time between blows: There is nearly always an increase of resistance and decrease of set per blow as an effect of an interval of rest, permitting the earth to settle firmly around the pile. The increase of resistance from a few minutes' to a few hours' rest may vary from 50% to several hundred or even thousand per cent. This effect is usually most pronounced in the finer, soft and wet earths, and least pronounced in coarse gravel and sand. No values of s should therefore be accepted as trustworthy without testing occasional piles for various intervals of rest, and the mean penetration for the first few blows after such an interval of rest should be taken as the value of s.

14. As to piles acting as columns. Assuming a blow of $3{,}000 \times 20 = 60{,}000$ ft.-lbs., a pile which penetrates through soft material to a comparatively hard stratum is not, as a rule, safe as a column (with a factor of safety of 6) for any heavier load than is given by the safe load formula of par. 8. That is to say, for a set of

1 ins.	2 ins.	3 ins.	4 ins.	5 ins.	6 ins.
the safe load in pounds by par. 8 is					
60,000	40,000	30,000	24,000	20,000	17,140

which is about 1-6 of the ultimate breaking load of a 10-in. round column of soft wood, of a height of

8 ft.	14 ft.	18 ft.	21 ft.	24 ft.	26 ft.

In cases where the length of column without side support is greater than this or the safe load by par. 8 is less, the safe load by the latter formula will exceed the safe load on the pile as a column.

15. Crushing strength. No pile can be relied on to bear without crushing over 500 to 1,000 lbs. per sq. in., unless of superior hard wood timber; or 50,000 to 100,000 lbs. in all, assuming the average section of pile to be 100 sq. ins. This is the safe load by par. 8 for a pile settling 1.4 to 0.2 ins. under a 20 ft. blow from a 3,000-lb. hammer. Therefore penetrations of soft wood piles of less than 1½ ins. under such a blow (or proportionately for weaker blows) are to be looked on with some suspicion on this account, and penetrations of less than ½ to ¼ in. are to be disregarded wholly in computing bearing power, and s taken as = 0.5 to 0.25.

16. Uplifting. Piles driven very close together in certain quicksandy or semi-fluid soils will sometimes rise somewhat when other piles are subsequently driven near them. While the precaution of giving them a few extra settling blows is expedient when time permits, they may be left as they are without much anxiety in most cases, as the phenomenon in piles that the lower material is already solidly in contact with the pile, giving as great bearing power as the nature of the soil permits, after the soil has settled solidly about them.

17. Bearing piles should be spaced at least 3 ft c. to c. each way if this gives a sufficient number to carry the load, and they are worse than wasted if driven less than 2½ ft. c. to c.

18. Variations of load for varying conditions. No experimental evidence exists that par. 8 does not give a safe load under all conditions of service, within the limits of usual values for w, h and s. The load, therefore, need never be made less than par. 8 permits unless for some special case of treacherous or dubious soil under an important structure subject to vibratory strains. An extra allowance, if made, should ordinarily be made by reducing the spacing between piles, down to a limit of 2½ ft. c. to c. On the other hand, the load should only be made greater than warranted by par. 8 with extreme caution, under favorable conditions for high bearing power only, and with care that pars. 14 and 15 be not infringed.

19. Computation of Loads: All extra loads

*Bearing Piles: Formulas for the Sustaining Power, Size and Distribution in any Foundation. By Rudolph Hering, M. Am. Soc. C. E., Eng. News Pub. Co., 25 cts. This pamphlet is now out of print, but a new edition of it will be prepared shortly, including the present article, and other matter which has appeared since or may soon appear no the subject, in these columns and elsewhere.

which may result from winds, locomotive counterweight strains or other temporary loadings are to be considered in computing the load on each pile. In pile trestles, it is none too great an allowance to assume that the entire weight of the driving wheel base falls upon each bent in succession.

C. Bearing Power of Piles driven by Method 2 (Hammer attached to hoisting rope).

20. When the weight of the hammer has not only to set the hammer in motion but also the hoisting rope and drum, the energy of the blow (= w h) is in increase ratio to the time taken for the hammer to fall a given distance free or attached to the rope, which may be observed experimentally or computed, assuming the mass of the drum to be concentrated at its radius of gyration from the center. It will usually be found to be diminished nearly one-half, which requires a corresponding reduction in the value of h, that variable being supposed to equal the height of free fall.

(Deception is often resorted to in contract work under this method of pile driving; the fall of the hammer being checked by the brake in a way which it is difficult to guard against by inspection. It is therefore a method to be avoided in contract work.)

D. Bearing Power of Piles driven by Method 3 (Water jet).

21. As a rule, the soils in which the water jet works to most advantage are those in which the hammer method cannot be used at all; i. e. in which the penetration will be little or nothing under any blows which the piles will sustain without crushing. If so, the loads which the piles will sustain are limited only by their crushing strength or strength as a column, pars. 14, 15; or the same as if driven by hammer with equally small penetrations. In important cases where there appears room for doubt, the piles should be tested either by loading or (preferably) by a few blows of a hammer after the material has had due chance to settle firmly about them. In fine fine river or sea sands, however, it is certain that the penetration would be very small under hammer blows, and hence the bearing power will be always high.

E. Bearing Power of Piles driven by Method 4 (Dead load).

22. As a rule piles sunk only by a dead load placed on them will not sustain safely much more than the load which sunk them, but will do that (and sometimes much more) after they have stood for a time, to let the material settle closely upon them. In very soft and semi-fluid muds, the safe bearing power may be many times the weight which originally sunk them. The only certain test is to try some of the piles with a hammer after they have been driven some time and then compute the bearing power by par. 8.

F. Bearing Power of Piles driven by Method 5 (Steam pile drivers).

23. As a rule, the interval of time between blows is not more than 1-10 to 1-20 as great as in ordinary pile driving, and the velocity of impact not over 1-3 as great. Therefore, the constant 1 in the formula of par. 8, which represents the extra initial resistance of getting the pile in motion again should not be over 1-10 as great, if so much. Calling it 0.1 for safety we have for the case of steam pile-driver piles:

$$\text{Safe load} = \frac{2\,wh}{s+0.1}$$

The same results will be reached if we retain the formula of par. 8, but let h = the total fall in feet in 10 blows, and 5 = the total set in inches in 10 blows. The formula as thus modified is at least not likely to give excessive loads in either case. If anything it is somewhat too conservative. There is a lack of experimental data on which to base any closer estimate.

G. Bearing Power of Piles driven by Method 6 (Gunpowder pile drivers).

The gunpowder pile-driver strikes nearly as quick blows with a considerably greater average fall than by Method 5, par. 23. Moreover, only half of the effect of each blow is due to the fall of the hammer; the other half is due to the resulting explosion which throws up the hammer for the next blow. Otherwise, the conditions are substantially the same as by par. 23. Hence for the safe load of piles thus driven we should have

$$\text{Safe load} = \frac{2\,wh \times 2}{S+0.1} = \frac{4\,wh}{S+0.1}$$

This formula is also likely to err on the safe side, if at all; but experimental proof of safety should be required before it is exceeded.

Such would be our suggested rules for the safe bearing power on piles to cover all cases and conditions likely to occur in practice as completely as it is possible to do so. We invite criticism upon them, and in the meantime submit them subject to correction. In a later issue we shall give such criticisms as are offered, and also some further notes and comments, in regard to this and other papers and discussions on pile-driving which have recently appeared in these columns.

LETTERS TO THE EDITOR.

THE FIRST QUADRUPLE-EXPANSION STATIONARY ENGINE.

Sir: On p. 409 of your issue of Nov. 3, we notice a statement that the first large quadruple-expansion engine to be built in this country has just been undertaken by the Dickson Mfg. Co., Scranton, Pa., the cylinder diameters being 26, 37, 52 and 72 ins., by 36-in. stroke.

Kindly allow us to call your attention to the fact that in 1887 the Edward P. Allis Co., at their Reliance Works, Milwaukee, Wis., built for the Warren Mfg. Co., Warren, R. I., a quadruple-expansion Reynolds-Corliss engine. This engine has cylinders 24, 36, 52½ and 64¼ ins. diameter, respectively, by 72 ins. stroke; and, unless we are very much misinformed, it was the first large quadruple-expansion stationary engine built in this country, and is the only one in operation up to this date. The engine was built from designs by Edwin Reynolds, Superintendent of the Reliance Works, and has been in operation for the last four years.

Yours truly,
The Edward P. Allis Co.

Chicago, Ill., Nov. 7, 1892.

(America appears to be in advance of England in the use of quadruple-expansion engines in stationary service. English builders of marine engines began expanding steam through four cylinders some four or five years ago, but the first quadruple-expansion engine built in England for stationary service has just been turned out by John Musgrave & Sons, of Bolton, for the Peel Spinning Co., of Bury. The engine is to use steam at 200 lbs. pressure and will develop 1,600 HP.—Ed.)

"B. C." and "E. C."

Sir: Referring to the query as to "A Problem in Railway Location," published in your issue of Oct. 13, 1892, I believe there must have been some sketch left out. I cannot get the sense of the symbols "B. C." and "E. C."

Yours truly,
Sr. von Empergie.

New York, Nov. 7, 1892.

(B. C. and E. C. signify "Beginning of Curve" and "End of Curve," being preferred by some engineers to the more familiar "P. C." and "P. T." (Point of Curve and Point of Tangency). The objection to the latter is only the theoretical one that, geometrically speaking, both the P. C. and P. T. are points of tangency, and points of curvature as well. For this reason certain purists object to them, but in our opinion unwisely and absurdly, for the reason that in railway location the line is always supposed to be advancing forward in the direction of the station numbers. Therefore the P. C. is in fact the point where curvature begins and the P. T. the point where tangent begins. Even in running a line backward, which is often necessary in practice, this convention is always respected. The stakes are numbered and faced and the P. C. and P. T. marked in as if the line were being run the other way, or with the numbers. Therefore, in no case is there any ambiguity, and in our judgment the time-honored terms P. C. and P. T. should continue to be used and the new-fangled B. C. and E. C. ignored.—Ed.)

A NEW TABLE OF SQUARES.

Sir: I desire to call the attention of your readers to the following:

In the near future I expect to publish a new table of squares for every foot and fraction thereof by sixteenths of inches up to 48 ft. 0 ins. I am aware of the existence of a somewhat similar table, containing the squares up to 50 ft.; but the tables which I am to publish are worked out, so that the squares of quantities above 48 ft. (up to 96 ft.) can be easily found also, if necessary, exact to 8 decimal places; whereas the tables now before the public, being exact only to two decimals, do not admit of like extension with accuracy.

My tables are formed by squaring the actual fractions, not using decimals before the squaring has been performed. Their compilation has been done entirely by myself and in such a manner that no error could sneak in without being discovered at once. To explain how it was accomplished (it took me about 150 hours) would fill too much valuable space; although, on request, I am willing later to give some details. Hoping that this article will awaken interest with all careful calculators and computers, I remain,

Yours truly, J. C. Nitter.

Baltimore, Md., Nov. 7, 1892.

(We have been compelled to omit from this communication some detail practical examples and theoretical discussion of formulas, in which Mr. Nitter appears fully to make good his claims.—Ed.)

WIND STRAINS IN MILL BUILDINGS.

Sir: Please note the following corrections to the formulas accompanying my paper on "Mill Building Construction," published in your last issue: Unwin's wind pressure formula on p. 448, bottom of third column, should read:

$$P = F \sin^{1.84} \cos^{1.84}$$

On p. 451, the first line of the nomenclature should read:

l = length of beam or column.

$$k = \frac{a}{l}$$

In formula (5), at the bottom of the first column, the coefficient 2 belonging to the quantity S^1_2, was omitted. Formula (7) should read in its last form:

$$M^2_x = S^1_2 (l - x) - P_2 (a - x) \text{ when } x < a.$$

In Formula 11 the third value of V_x is when x = zero, a fact which is not evident from the punctuation.

In the quantities M^1x, M^2x, M^1a and M^2a I intended to have the "x" and "a" printed as subscripts, which would have made the discussion somewhat easier to follow.

Yours truly,
Geo. H. Hutchinson.

Pittsburg, Pa., Nov. 11, 1892.

BAD MILL BUILDING CONSTRUCTION.

Sir: In yesterday's issue I notice a seemingly very complete article on "Mill Building Construction" by Geo. H. Hutchinson, Assoc. M. Am. Soc. C. E., and read with interest under "General Conclusions" his remarks on the desirability of heavier loading, etc., for this class of work. From my own experience, while in the employ of contractors for this class of work I should say that Mr. Hutchinson has stated the case very mildly indeed.

Very frequently when manufacturers of such work are invited to submit plans and a proposal, the only data which the intending purchaser can furnish are the dimensions of the building, and about the height desired. The purchaser being a business (?) man, can see no necessity of employing an engineer to prepare plans of the proposed structure, and trusts to the integrity of the bidders to design a "first class" structure.

The designs received, however, will, as a rule, under such circumstances, fall far short of such as are represented in Mr. Hutchinson's article. If a bidder should prepare plans with the same degree of care with which those published seem to have been evolved, his design would be very promptly "knocked out" by some "feather weight" which would be offered at about one-half the price. That there are concerns of considerable notoriety, as manufacturers of mill buildings, that submit designs figured with a phenomenally light loading and designed to carry the load with a factor of safety of 3 and less, I am quite positive, as I have seen a number of such. To the purchaser, however, they are all about as legible as a Chinese puzzle, and being an economical (?) man in his business affairs he will, in almost every case, take the cheapest. As this class of work has assumed large proportions only within the past decade, the record of failures of such buildings has not been as great as might reasonably be looked for.

For the very reason above indicated, concerns employing able engineering talent, and priding themselves on good design and construction, are compelled either to come down to this flimsy construction in their designs or go out of the business; for to nine out of ten purchasers the hieroglyphics appearing on a strain sheet are of small consequence, provided the building when finished is resplendent with bright red paint, and does not succomb to the first wind storm.

Mr. Hutchinson also refers under "General Conclusions" to the fact that there are other causes for which larger sections should be used, than the direct action of wind, or the provision for snow loads, the weight of the structure, traveling cranes, etc. One most important consideration, as I regard it, is the corrosive effects of sulphur and other gases, where such exist, which in a short period will transform 3-16-in. and ¼-in. metal into a mere scale not as thick as a sheet of "American tin."

As an effective preventive for such corrosion has

not apparently been discovered as yet, it certainly should be defied for a considerable time at least by using a surplus of metal in the thickness.

Another condition poorly provided for in very many cases is that, where shafting attaches to the roof trusses or columns. Aside from the direct strains induced by such an arrangement, there is often an amount of vibration due to the running of the shafting and the attachment of machinery, which can only be reduced by a liberal supply of efficient bracing.

Where wind is the prime consideration, buildings of the type referred to in this letter are often quite s fe, as they rarely, if ever, get the load for which they are designed, a fact which should cause many owners of such to congratulate themselves.

The shortsighted economy of purchasers in refusing to avail themselves of the services of engineers who are experienced in designing and supervising such work will be recognized by the profession, and might readily be by others; if we suppose, for example, that designs and proposals for such a plant are invited from 10 companies (not an unusual number, as frequently many more are asked to bid). Ten engineers for the ten companies prepare a plan each; a "skin" plan most likely, and very often a quite hurried one, but the time occupied all goes into the engineering expenses of each concern, and must at least be paid for by the buyer, so that he pays for the time of ten engineers, making ten "skin" plans rather than for one engineer to design a piece of work precisely adopted to his ideas, and up to the requirements.

Assuming that iron mill building construction is now in the depraved condition that highway bridge construction once was, and even is yet in too many cases, it is very difficult to imagine how a reform is to be brought about, since work of a higher grade would cost enough more in many instances to deter the buyer from building of iron at all, if brick walls and wooden roofs could be substituted, as might frequently be done.

A minimum of metal has, therefore, often to be used, or else other material would be used, and few concerns doing this class of contract work would wish to see this happen very often. Iron highway bridges, while being introduced into many portions of the South as a novelty, have even yet to be designed to compete in price with the wooden ones built by local contractors.

Many such bridges have failed, and have defeated the very end for which they were introduced, as the commissioners could often point to wooden bridges 30 and 40 years old, yet standing in fair condition, and hesitate to purchase unreliable iron ones. With the too prevalent light construction of the mill buildings, the same result may in time be attained, as the existing ones still have youth in their favor in a majority of cases.

Yours truly,

F. W. Wilson,

Bridge Dept., N. Y. C. & H. R. R. R.

New York, Nov. 11, 1892.

(We are about to publish some drawings bearing startling evidence to the deterioration from corrosion which sometimes occurs, as alluded to in this letter.—Ed.)

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

XXXII.

Addendum as to the Membership in Am. Soc. C. E.

In view of the fact that our original information as to the number of graduates from the several engineering schools who were members of the American Society of Civil Engineers (Eng. News, Oct. 20-27) covered only 668 out of a possible 1,135 members, and of the further fact that some doubts and questions have been expressed as to the entire fairness of that comparative summary (Table XXVII., p. 375), we have thought it well to obtain complete information on this head, so far as it existed in the records of the society, and it is presented in the following Table XXXII. for practically the entire membership, as follows:

No. of members heretofore reported	668
No. of members since reported	405
Total reported	1,073
No. of members admitted prior to 1872 without filing any record	54
Total No. members covered by return	1,127
Total No. by last List of Members	1,135

The fractional difference of 8 is due only to the fact that substantial completeness only was aimed at, and not absolute completeness for the membership at any particular date.

Of the 668 members who voluntarily sent in reports to us, 410 in all, or 61.4% proved to be graduates* of some engineering school, whereas of the 405 since reported by reference to the records of the society only 120, or 29.6%, proved to be graduates. From this fact it is clear that a larger proportion of non-graduates than of graduates failed to fill out our circular, as was not unnatural in view of the fact that our inquiry was specifically stated to be made with a view of determining the comparative contributions of the several schools to the society membership. A certain reluctance to go on record as a non-graduate (though the record was in no way personal) may also have had its effect.

But as among the graduates only, the more complete return has affected very little, if at all, the relative representation of the several engineering schools in the Am. Soc. C. E. membership. Thus, the new returns add 29.3% to the total number of graduates. In this ratio the R. P. I. record should be increased by 29; it is actually increased by 31. Yale should have 3 more; it has 5. The University of Michigan should have 6, and has it. The Mass. Inst. Tech. should have 10 and has 7, and so on through the list.

We therefore compute the percentage of the total number of available graduates from each school who are M. Am. Soc. C. E. with renewed and greater confidence that it must give a substantially fair comparison between the several schools except for one important fact. We have no means of knowing from what particular course in engineering each M. Am. Soc. C. E. graduated, and hence have to give the total from all courses for each college. On the other hand we do know it to be the rule that only graduates in civil engineering join the Am. Soc. C. E., the mechanical graduates gravitating rather toward the Am. Soc. M. E. and the mining graduates toward the Am. Inst. M. E.

Therefore we are obliged as a choice of evils, to divide the total number of reported M. Am. Soc. C. E.'s among graduates from ALL engineering courses of each school by the total number of graduates in civil engineering only in order to determine the percentage. This works against the school having no other engineering course but a civil one, obviously, but any other rule would be vastly more unfair. We have good reason to believe that the error is not more than 1-10 to 1/8 part in the case of any school.

On the other hand the three oldest schools in the list at least (Nos. 1, 2, 3) gain a certain decided advantage from the way the table was made up from the fact that none of their graduates prior to 1860 were counted in among the possible contributors to the membership of the society. This was originally done on the ground that, as the society was not reorganized until 1867, and did not become strong for ten years later, the older graduates had but little inducement to join the society.

As a matter of fact, however, we find that the R. P. I., for example, had 59 graduates in the five years 1855-59, among whom a larger percentage than of any other group of 59 in the list, perhaps, are now M. Am. Soc. C. E.'s. As two of these schools are exclusively civil engineering, and the third was chiefly so during the dates covered, we leave to these schools this fractional advantage as a partial (and in our judgment, complete) offset to the other source of error mentioned.

Again repeating our caution, however, that there are too many causes of accidental variation to accept this as in any degree a fair guide to the respective merits of the separate individual schools, we deem that this list bears most striking and impressive testimony to the difference in the quality of instruction given by different CLASSES of schools. How little the added information has changed the apparent relative status of the several schools is evident from the following comparative tabulation of (1) the per cent. of their graduates between 1860 and 1884 who are M. Am. Soc. C. E. by the full report and (2) the same per cent. by uniform partial report.

	P. c. by full report.	P. c. by partial report.
1, Mass. Inst. of Technology*	38.6	32.2
2, Rensselaer Pol. Inst.	28.2**	21.5
3, Washington Univ. St. Louis*	25.7	20.0
4, Sheffield Sci. School*	16.7**	16.6
5, Columbia Coll. Sch. of M.*	18.3	16.7
6, Lehigh University*	16.7	15.1
7, Washington & Lee Univ.	16.7	11.9
8, Union College	15.1	9.2
9' Worcester Pol. Inst.*	14.8	12.5
10, Lawrence Sci. School	14.0**	10.5
11, Univ of Illinois*	13.6	13.6
12, Univ. of Michigan*	13.0	10.6
13, Cornell Univ. Coll. C. E.	13.1	9.7
14, Dartmouth	12.8	12.0

* These colleges have more than one engineering course, so that they are somewhat favored comparatively, as elsewhere explained, by perhaps 1-8 to 1-10 of their apparent percentage.

** These colleges are somewhat favored by having their graduates prior to 1860 neglected as possible contributors to the membership of the Am. Soc. C. E. If the graduates from 1855 inclusive were included, as would in some ways be fair, their percentages in the first column would stand thus: R. P. I., 24.9 instead of 28.2; Sheffield, 17.9 instead of 18.8; Lawrence, 9.6 instead of 14.0.

The University of Kansas, with 50% of its engineering graduates appearing to be in the society, and the University of Virginia, with 37.1%, are omitted from this summary, partly because the number of graduates covered is too small to give fair average, and partly because their high percentage probably arises in part by inclusion of graduates from the classical courses.

The influence of locality is also to be remembered as making against the Western schools, and it is but fair also to call attention to the fact that Yale (Sheffield) is favored by two causes as explained in the two foot notes above, and Union, Cornell and Dartmouth are favored by none, while the others are favored by one each.

But after making all allowances, who will question that every one of these 14 schools would be found in a perfect list of the 20 engineering schools which were at the present time absolutely the best for training civil engineers to succeed as such? There is one school in the list, or possibly two, which might not get into it on their own present technical merits alone, but then they have enormous advantages in their atmosphere, surroundings, scholarly traditions and large body of alumni, all of which count in weighing the absolute advantages of the several schools, though they do not count in weighing the comparative excellence of management. It is one of the saddest features of a record of non-success for such a school that it takes a great deal of bad and slip-shod management to prevent a school enjoying advantages of this kind (for which no one but Providence deserves any credit) from going and keeping to the

Table XXXII.—Number of Graduates and Non-Graduates of the Several Engineering Schools in the Entire Corporate Membership of the American Society of Civil Engineers (a few of unknown record alone excepted).

	A. Previously reported.			B. Since reported.		
	A.	B.	Tot'l.	No. C.E. grads. 1860-1884 incl.		P. c. now M. Am. Soc. C. E.
Not graduates	213	287	489			
Grads. foreign schools	45	18	63			
Grads. home schools (as follows)	410	120	530			
U. S. Military Acad.	21	9	30			
U. S. Naval Acad.	4	2	6			
1. Rens. Pol. Inst.	90	31	130	462	....	28.2
2. Lawrence S. S.	9	3	12	86	...	14.0
3. Sheffield S. S.	37	5	42	223	(3.5)	18.8
4. Dartmouth	16	1	17	133	...	12 8
5. Union	17	11	28	185	...	15.1
6. Univ. Mich.	21	6	27	198	(229)	13.6
7. Brk'n Pol. Inst	2	1	3	103		2.9
8. Pa. Mil. Acad.	1	...	1	171		0.6
9. Columbia	10	1	11	60	(341)	18 3
10. Wash. and Lee	5	2	7	42		16.7
11. Mass. Inst. Tech.	35	7	42	109	(258)	28 6
12. Lehigh	10	1	11	66	(118)	16 7
13. Univ. Va.	8	2	10	27		37.1
14. Cornell	17	6	23	176		13.1
17. Lafayette	3	...	3	79	(110)	3.8
18 Wash. Univ	7	2	9	35	(67)	25 7
19. Univ. Vt.	2	...	2	32		6.2
21. Worc. Pol. Inst.	11	2	13	88	(232)	14.8
23. Ms. Agr. Coll.	3	2	5	77	(104)	6.5
25. Univ. Pa.	5	2	7	84		8.4
26. Stevens	4	1	5	100	(168)	5.0
27. Univ. Wis.	1	...	1	35	(57)	2.9
28. Thayer (Post. Grads.; included with Dart.)	...	...	...	.....		...
29. Swarthmore	1	...	1	32	....	3.1
32. Univ. Cal.	1	...	1	62	(103)	1.6
33. Univ. Kan.	4	...	4	8		50.0
34. Univ. Minn.	1	...	1	14	(16)	9.2
35. Rutgers	4	...	4	67	....	6.0
38. Univ. Ill.	3	...	3	22	(48)	13 6
39. Univ. Cinc.	1	1	2	15	....	13.3
40. Princeton	2	1	3	35	....	8.6
45. State Col. Pa.	2	...	2	1	....	100.+
50. Mich. Agr. C.	..	1	1	Not known		
Polyt. Coll. Pa.	11	8	19	"		
Univ. N. Y.	6	3	9	"		
Univ. Ala.	1	...	1	"		
Va. Mil. Acad.	5	3	8	"		
Brown Univ.	2	...	2	"		
O. State Univ.	1	...	1	"		
Mass. Agr. Coll.	1	...	1	"		
Haverford	1	1	2	"		
Bowdoin	1	2	3	"		
Others	14	3	17	"		
Total	668	405	1,073			

* As was explained in our former article we included among the "graduates" in every case those whose responses indicated that they had taken over two years of the regular course at any engineering school, though they left before receiving a degree. There were but few of these cases (relatively), and we do not believe it has affected the relative, but only the absolute number of graduates reported.

front in spite of all competitors who have nothing but recently acquired merit in their favor. If in spite of such advantages a school goes not forward but backward, how great is the reproach to its management!

A correspondent suggests to us in regard to the above table and its predecessor that "it would be a matter of justice to the older schools and conducive to more accurate results to include members deceased in the table." Perhaps it would, but there are two reasons to the contrary: (1) We cannot ask questions of deceased members, or if we do can get no responses. (2) We have already favored the older schools sufficiently in counting in none of their graduates prior to 1860.

A correspondent below questions if our total for the Massachusetts Institute of Technology is not too large. It certainly is not if our responses from individual members were correct; it was too carefully checked. Possibly he tallied graduates in civil engineering only; possibly the M. I. T. had a larger percentage than others who accepted engagements before completing the whole of their course and so do not appear in the list of graduates.

RENSSELAER AND THE MASS. INST. TECH. IN THE AM. SOC. C. E.

Sir: I have read the article on the Engineering Schools of the United States, in your edition of Oct. 20, 1892, with interest, and have formed a table similar to your No. XXVII. for two of the schools mentioned, in a manner somewhat different from that by which you determined the number of M. Am. Soc. C. E. who are graduates of these institutions. The schools compared are the Rensselaer Polytechnic Institute and the Massachusetts Institute of Technology, and the numbers given were obtained by taking the latest catalogues of these institutions and comparing them with the latest list of members issued by the American Society of Civil Engineers. This method gives more definite and accurate results than that used by you, since you did not receive answers to all your letters of inquiry. From the nature of the case the results given below may be in error by a per cent. or two either way, but I am quite sure that your table is in error in showing 35 C. E. graduates of the M. I. T., to be M. Am. Soc. C. E. Their catalogue shows only 24 altogether now alive, and of these 4 are not C. E. graduates. Two graduates of that school who were M. Am. Soc. C. E. are now dead. I have properly included in this table the deceased as well as the living members of the Society. It is to be noticed that the results shown here do not give the exact percentage as at present existing, as the membership of the Society has, of course, changed since the last list of members was issued, a number of our graduates having since become members to my knowledge, but it is believed that the variation from this percentage is not great:

Name of School.	Number admitted as M. Am. Soc. C. E. in 1867-9	1870-4	1875-9	1880-4	1885-9	1890-2.	Total.	No. C. E. grads. 1860-94 inclusive.	Per cent. now M. Am. Soc. C. E.
Rens. Poly. Inst...	24	17	12	27	36	13	129	468	28 0
Mass. Inst. Tech..			1	8	9	9	22	110	20.0

It will be noticed that the percentage is 28.0 for the Rensselaer Polytechnic Institute and 20.0 for the Massachusetts Institute of Technology. It may be interesting to note that of the living M. Am. Soc. C. E. given in the last list of members, 118 are graduates of the Rensselaer Polytechnic Institute, that is, 10.6% of the whole number, and 9.0% of the junior members are graduates of the same school. There are given in this list of members, including living and dead, of all classes, 155 names of graduates of this institution.

It is not necessary to say in closing that no individious comparison is intended by the figures given above. No one has a higher opinion of the work done by the Massachusetts school than I, but if such comparisons are to be made, no school need fear them less than this one, and, judging from the fairness and justice with which all schools have been treated by Engineering News in this series of articles, I am sure you will be glad to find space for this letter in your columns. Palmer C. Ricketts.

Troy, N. Y., Nov. 5, 1892.

(Since the original article was prepared on which this letter is a comment we have obtained substantially complete reports as to the "alma mater" of the entire membership of the Am. Soc. C. E., the results of which appear above. Whatever view be taken of the facts otherwise, we trust we have made it sufficiently clear that we did not and do not regard the comparison as at all a sufficient basis for inferring the order of merit of single colleges. The general fact that the engineering schools which stand high have a very large percentage of their total graduates in the membership of the Am. Soc. C. E., while those less known by reputation have a smaller percentage, was clearly and strikingly brought out, and was a fact of no small significance, in our judgment. The place of any particular college in the list, however, might well be determined by some accidental circumstance like locality. Other things being equal, for example, the R. P. I. ought to have a somewhat larger per cent. of its graduates in the Am. Soc. C. E. than the M. I. T., because it is a New York institution, and the "local attraction" of the Am. Soc. C. E. is stronger in New York than elsewhere. —Ed.)

AN ELLIPSOGRAPH.

By J. E. G. Yalden.

The following instrument was designed by the writer as a simple means of constructing elliptic figures varying in eccentricity. An engineer or draftsman frequently has occasion to construct some permanent elliptic forms, and although this can easily be done by the old method of points, drawings the curves and cutting out the figures, I believe it can be done more accurately and quickly by the use of this simple apparatus.

There are many forms of ellipsographs on the market; but they are expensive, and at the same time require almost as much care in operating as this, and in most cases the figure drawn has to be cut out in precisely the same manner. It is also difficult to construct ellipses of small eccentricity with them, while with this an elliptic figure of small eccentricity may readily be formed.

The instrument is based on the principle of orthographic projection. The projection of the plane of a circle upon a ground plane, when the two planes are parallel to one another, is a circle; but as the plane of the circle is produced about an axis the projection upon the ground plane becomes an ellipse, varying in minor axis as the circle revolves; till finally when the plane of the circle becomes perpendicular to the ground plane the projection becomes a straight line, with a length equal to the diameter of the circle.

The instrument consists of a box open in front and on top, of any convenient size, so arranged with a hinged bottom as to be inclined to the plane of the table, to face directly the source of light.

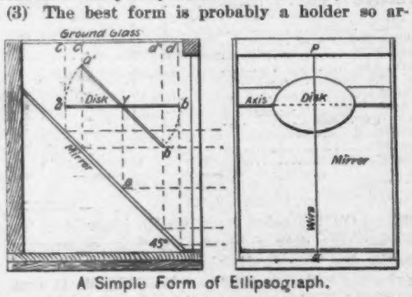
A mirror is placed inside inclined at an angle of 45°; and a piece of ground glass forms the top. Two pencil lines should be drawn on this glass through its center and perpendicular respectively to the side and ends of the box.

Several forms of disk carriers may be used; these being placed at the point Y in the figure. The major axis of the ellipses produced being always constant for a given disk; the minor axis varying from its diameter to a point. These disks may be:

(1) A circle of card of the required diameter mounted on an axis.

(2) A sheet of thin glass mounted on an axis with a fixed center for a compass leg. Upon this circles of the required diameter may be drawn in india ink. They may be afterwards easily erased.

(3) The best form is probably a holder so arranged with a groove that squares of card with a circular hole cut in them may be easily placed in it.



A Simple Form of Ellipsograph.

These cards no doubt, everyone can easily prepare; but a method used by the writer is very simple and efficient and may be unknown to some. A square of card is placed on a drawing board, and a strip of heavier card is placed on top and pinned through the center of required circle. A knife blade is inserted in the strip at a point distant from the pin equal to the radius of the circular hole desired. The card is turned several times; the knife in this way cutting a true and clean circle. In using the instrument, it should be placed facing the source of light. This may be accomplished by turning the box from left to right till the shadow of the wire P. Q. coincides approximately with the line drawn through the center of the ground glass.

It should then be inclined so that a ray from the source of light shall enter parallel to the plane of the ground glass. Under these conditions the best results are obtained; viz., the most sharply defined shadow.

A disk prepared with the required diameter, is placed in the carrier, and revolved till the ellipse projected on the ground glass has the required minor axis.

A piece of paper may then be placed on the glass, and the figure traced directly; then mounted on cardboard and afterwards cut out. What is still much better and far more accurate, requiring no skill in tracing, is to place a piece of blue print (Ferro-type paper) on the ground glass, this being afterward treated as before.

The cutting out of the figures is easily accomplished, a sharp pair of scissors being the best thing to use.

With ellipsographs of the trammel type, and those formed on the projection principle, it is impossible to construct very small ellipses owing to the size of the parts of the instrument.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Effect of Excepting Street from Deed.

Where a contract to convey land in a city specified two parcels between which was a strip that had been surveyed as a street, but had never been conveyed to the city as a street or otherwise, and the deed given pursuant to the contract described the land as one parcel, and included the strip, but excepted "the street heretofore deeded to the city," the exception excluded the strip from the operation of the deed, since the recital in the excepting clause that the strip was "deeded" to the city was merely descriptive of the strip. (Rushton v. Hallett. Supr. Ct. of Utah, 30 Pac. Rep., 1014.)

Right of Drainage.

A landowner has the right to discharge the surface water of his land, and such as comes naturally thereon, through a drain upon an adjoining owner, but not to increase the discharge to such an extent as to overflow, by changing the course of drains already established and having other outlets. But the existence of a drain many years before, along a certain line, does not give one the right to reopen same, regardless of the consequences to an adjoining owner resulting from the increased flow. (Osten v. Jerome. Supr. Ct. Mich., 53 N. W. Rep., 7.)

Not Necessary to Refer to Landmark or Survey.

In an action of ejectment to recover certain real estate, which the petition described by metes and bounds, commencing at the S. E. corner of the N. W. ¼ of the N. ¼ of a specified section, town, and range, a motion to make the petition more definite and certain by requiring the plaintiff to set forth therein by some definite landmark or survey where said corner is situated, was held properly overruled. (Mills v. Traver. Supr. Ct. Neb., 53 N. W. Rep., 67.)

Municipal Liability for Change of Street Grade.

Under a constitution which declares that "municipal and other corporations. . . . shall make just compensation for property taken, injured, or destroyed by the construction or enlargement of their works, highways, or improvements," one who has built a house on his lot in conformity with the existing physical grade of an old public highway in front of the lot, may recover from the city damage to the lot resulting from a change in grade. But, where a city changes the grade of the street, it is not liable to the abutting lot owner for damages resulting therefrom to a house erected on the lot after the change in grade was authorized. (O'Brien & Groff v. City of Phila. Supr. Ct., Pa., 20 At. Rep., 1,047.

Expense of Changing Grade of Street.

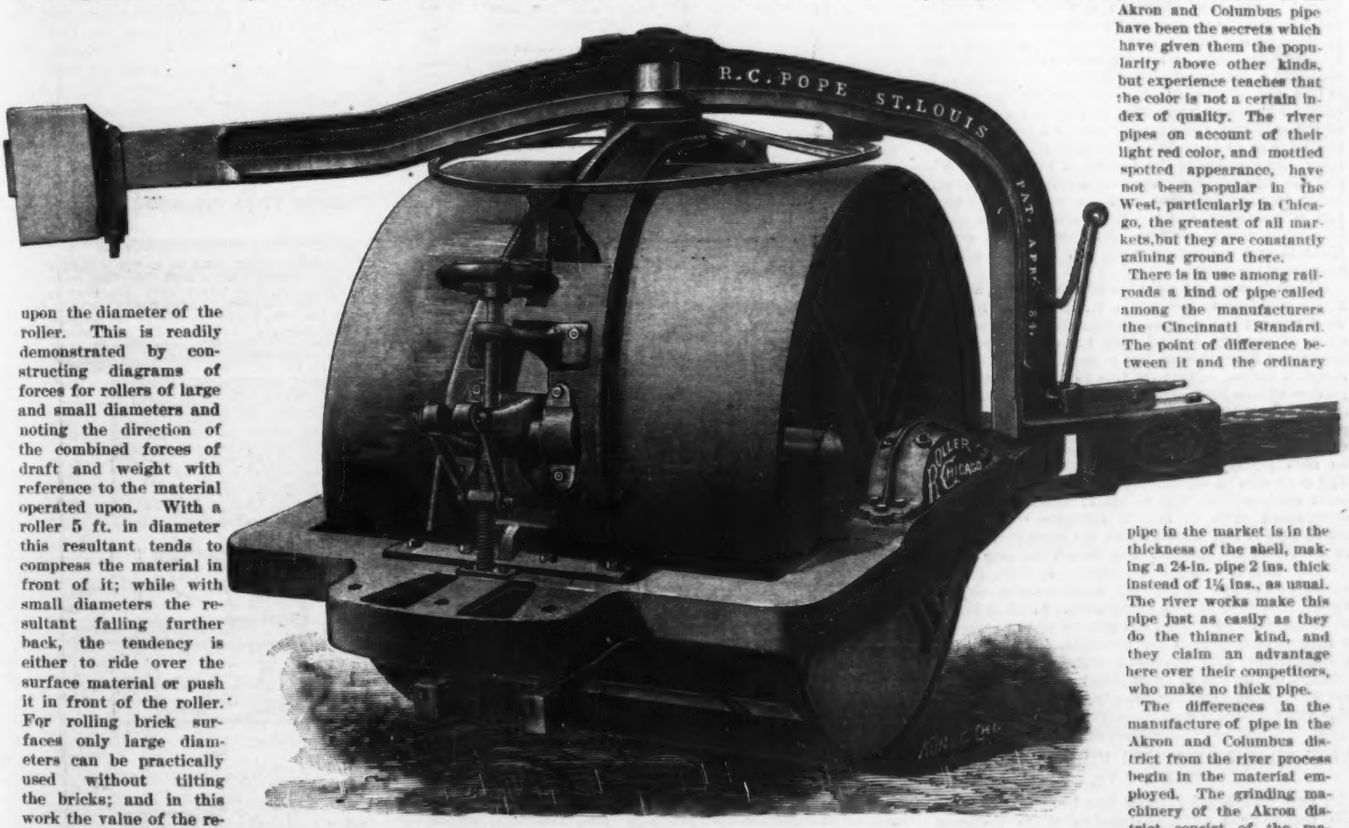
Where a Connecticut borough charter, conferring power to order owners of land abutting on public streets to construct sidewalks at their own expense, provides that when, in pursuance of such order, an owner builds a sidewalk, and it is deemed necessary by the borough to change the same within 10 years thereafter, such change must be made at the borough's expense, the statutes of the state also providing that where the abutting owner shall sustain special damage by a change of grade of highway, the borough making the change shall be liable therefor, raising the grade of a street by a borough necessitating laying a new sidewalk in place of a perfect existing sidewalk, which was built more than 10 years before at the expense of the owner, the borough is not liable for the cost thereof. And the fact that such change of grade rendered useless an abutting owner's steps which projected into the sidewalk, and which he had used without objection for 20 years as a means of access to his basement, is not an element of special damage; the borough charter conferring "sole and exclusive authority and control over all streets," and he having acquired no right to obstruct any part of the sidewalk with steps. (Shelton v. Borough of Birmingham. Supr. Ct. of Errors of Conn., 24 At. Rep., 979.)

THE POPE REVERSIBLE STREET ROLLER.

The cut given herewith illustrates the reversible street roller adopted in the reconstruction of streets in St. Louis, Mo., and severely tested in the building of about 146 miles of streets in that city in the last eight years. It is also extensively used in other cities, chiefly in the West. As seen in the cut given of a 7-ton street-roller, it is very simple in design and strongly made, with an iron frame, adjustable extra weight, anti-friction bearings, and powerful eccentric brake for downgrade work. The rollers of all weights have a standard width of 5 ft., and they are divided into two parts at the middle. The cutting of the surface in turning is avoided by simply reversing the 6-in. square tongue on the return trip. It is readily operated by one man and four horses.

The latest feature of this roller is the eccentric roller brake shown in the rear of the roller and operated by a hand-wheel and quick-threaded screw. It is positive in action and holds the roller in check going down hill.

Mr. R. C. Pope, of Chicago, Ill., the inventor and builder of these rollers claims that the good work done by his machines in St. Louis and other cities proves that the efficiency of a sub-grade or surface roller depends not so much upon its dead weight as upon the diameter of the roller. This is readily demonstrated by constructing diagrams of forces for rollers of large and small diameters and noting the direction of the combined forces of draft and weight with reference to the material operated upon. With a roller 5 ft. in diameter this resultant tends to compress the material in front of it; while with small diameters the resultant falling further back, the tendency is either to ride over the surface material or push it in front of the roller. For rolling brick surfaces only large diameters can be practically used without tilting the bricks; and in this work the value of the reversible feature of a roller is especially evident.



THE POPE REVERSIBLE STREET ROLLER.

From his experience Mr. Pope has adopted 5 ft. diameter and a 5 ft. face, with 10,000 lbs. weight, as his standard roller, and proportions all large rollers upon this type. His general rule for increase is that every additional 333⅓ lbs. of weight, above 10,000 lbs., represents an increase of one inch in diameter over 60 ins. Thus, a 6-ton roller would be 5½ ft. in diameter, a 7-ton roller 6 ft., and a 10-ton roller 7½ ft. in diameter, all on a uniform face of 60 ins., or 5 ft. The pressure per lineal inch of face represented by these rollers would be 166 lbs. for the 5-ton roller; 200 lbs. for the 6-ton and 233 lbs. for the 7-ton roller.

The new St. Louis telford pavements had their 6 in. surface of clean macadam, on 8 ins. of random stone wedged with spawls, thoroughly rolled by a 10,000-lb. four-horse roller, 5 ft. in diameter and 5 ft. face, and the surface was then finished with 2 ins. of cement, gravel rolled, then 2 ins. of coarse clean gravel, well wetted down and thoroughly rolled to a compact, smooth surface. On a cross-section of 60 ft. wide, 0.8 camber and average grade of 1%, the cost complete, exclusive of curb, was 12 cts. per square foot. The observed traffic on such a street, in 1890, was 1,500 vehicles in 10 hours; 65% of these were one-horse; 15% two-horse (on springs) and 20% two-horse, hauling dirt, building material and coal. In 1890 the repairs on the avenue so made, aggregating 469,500 sq. ft. of surface was one-half cent per square foot.

The same builders make a 7,000-lb. roller especially adapted for building county roads. This roller is 50 ins. in diameter and has a 50-in. face, and can be made with boxes to increase the load up to 9,000 lbs. Two or three horses are required according to the weight. A paver's one-man roller is also made.

The excellent character of the St. Louis pavements is attested by the fact that they carried without showing wheel marks a four-wheeled, broad-tired wagon, weighing 10,000 lbs., loaded with a coil of cable weighing 97,620 lbs., or 107,620 lbs. in all. The width of tire is not given, but the load of nearly 14 tons per wheel was a severe one on any pavement. The prices of the street rollers described range from $525, for the 5-ton, to $1,050 for the 10-ton rollers; but all further information can be obtained from Mr. R. C. Pope, Chamber of Commerce Building, Chicago, Ill.

SEWER PIPE MANUFACTURE.

In our issue of June 23, 1892, we illustrated and described the manufacture of sewer pipe as carried on at the works of Evens & Howard, of St. Louis. In a recent issue of "The Brickmaker" a writer gives a somewhat similar description of the process as carried on in the great Ohio pipe works and explains as follows the distinction between the "river" pipe and that produced at the works about Akron and Columbus.

The "river pipe" manufactured in Ohio is made from a homogeneous clay that is reduced to a fine, even state of division, and by the tempering plant is made into a perfectly uniform paste. As it enters the pressing chamber in a comparatively fine state, the force which compresses it does not make the lines of demarcation between the particles which composed the mass apparent as they would be if the clay were not as soft as it is, and as finely divided. So when a piece of river pipe is broken, its fracture shows an even, fine-grained structure, not so fine as stoneware, but very similar, and varying from a buff to a grayish-blue. This latter is the best tint to get as it insures the combination of whatever impurity the clay contains with the free sand, and development of the best qualities of the clay. The use of salt makes the color a necessity, as a rule, for the combination of iron always begins before the glazing by salt vapor does. The strength that these pipe have is far in advance of any other Ohio pipe, as the structure, seen by the fracture, would indicate. The degree of heat which the clay will stand without injurious effects is far above the glazing heat of the pipe, and the only precaution to be observed in the burning is to secure enough heat, with no close limit on the side of excess.

The iron found in these Kittanning clays is present in small grains, which, under the action of the salt glaze, make unsightly black blisters and holes in the surface, though in no degree injuring the utility of the ware; this feature has hitherto much injured its popularity, but it is beginning to receive more credit than ever before, because its superior strength and durability are being recognized.

The color of the river pipe is light red; in spots, where the heat did not get access to it, it is light-buff, and in over-burnt portions, a dark red color, which has not a pleasing effect. The even, beautiful red color of the Akron and Columbus pipe have been the secrets which have given them the popularity above other kinds, but experience teaches that the color is not a certain index of quality. The river pipes on account of their light red color, and mottled spotted appearance, have not been popular in the West, particularly in Chicago, the greatest of all markets, but they are constantly gaining ground there.

There is in use among railroads a kind of pipe called among the manufacturers the Cincinnati Standard. The point of difference between it and the ordinary pipe in the market is in the thickness of the shell, making a 24-in. pipe 2 ins. thick instead of 1¼ ins., as usual. The river works make this pipe just as easily as they do the thinner kind, and they claim an advantage here over their competitors, who make no thick pipe.

The differences in the manufacture of pipe in the Akron and Columbus district from the river process begin in the material employed. The grinding machinery of the Akron district consist of the machines called tracers. The tracer is an excellent machine for grinding a true clay of a sandy or plastic nature, but though its work in shale is successful, yet it seems as if the heavy, wet mill of a fire-brick works could not fail to be better. It would at any rate grind much more in the same time than the tracer, if it did not grind it any better. The fracture of an Akron-made sewer pipe shows frequently small pieces of shale which have escaped the wheels; and, in burning, these pieces usually shrink away from the bond clay so as to make a loose spot in the pipe, and they are consequently weakening in their effect.

The clay is tempered very stiff and is shoveled when ground into a squeezer of either the screw or piston type, and is concentrated into a long compact cylinder about 6 ins. or 8 ins. in diameter. This is cut up in lengths of about 15 lbs. weight and is fed to the machine in that shape. From this results the worst trouble of the Akron pipe. The stiffness of the clay and the large, well-compressed wads in which it is fed, act together in keeping the clay from uniting to a homogeneous mass. Even under the powerful pressure of the machine the lines of demarcation between the

different pieces going to make up a pipe, are plainly to be seen on the fracture of a burned pipe. They are arranged in circles concentric to the outside of the pipe, and often a crack of 1-16 in. separates the layers of the clay. This is all developed on burning, but is not visible before to any such degree. The working of the clay is admirable. It issues from the press as smooth as if moulded with oil, and the sockets are beautifully true and correct. The kilns used are the same as are used for burning stone-ware; they are oblong, end-fired, down-drafts, about 30 to 35 ft. long, and 15 to 20 ft. wide, with an average capacity of about 40 tons. The burning takes six days.

The character of Akron sewer pipe ware has already been hinted at in the description of the river pipe. It is a smooth, handsome ware, well-shaped, of a beautiful dark red-brown color, and remarkably uniform. On its fracture it shows the red color of a brick or even a darker, which demonstrates the presence of iron in that peculiar state so hard to define, which is necessary to the development of the high color; the percentage of iron must be high, yet but little of that offensive blotching seen on the river-made ware can be noticed. The weakening of the whole structure by the concentric cracks due to the pressing is the worst fault of the pipe.

As to the inability of the Akron works to make the Cincinnati standard pipe, this is to be said: The increase of thickness of their pipe, with the same amount of drying which they now give it, is liable to cause large flakes to spall off from the sides of the pipe when heated in the kiln. With a longer and hotter drying they could make these thick pipe, but as their capacity is used to the fullest rate now, they are under no necessity to begin its manufacture. One point where they hold a decided advantage over the river district, is in the use of the patent device for making curves, elbows,, S's and traps. They can control the position of the core inside the mud-drums by a lever, and by moving it so as to make one aperture smaller than the other the clay issues the fastest on the thinnest side and the pipe takes a curved shape. Also, by using a softer clay on one side than the other, the softest part issues faster, and the pipe curves. The movable core is so nicely controlled that such curves as the letter S, and the stench traps, can be made without help from the hands.

The catalogues and circulars of the Akron manufacturers claim that they sell a vitrified pipe. But the word vitrified has a definite signification. It would require, if properly applied, that the clay should have been fused to a glass, or that it should have undergone incipient fusion, or that its free silica and fluxing impurities should have been made to combine. But none of these conditions are met. The fracture of the Akron pipe is not in the least vitreous. On the contrary, particles of the mass, such as pieces of shale, can frequently be seen separate and distinct from the body clay. The color also of combined oxide of iron and silica is dark, running from blue to black, while the color of uncombined oxide of iron is red; the color of the Akron pipe is red, showing that the impurities are not in a state of combination. But though the pipe is not vitrified, it is probably better than if it were, for the excess of the iron in the clay would tend to make it brittle, if it were in real combination. In other words, vitrification would present not only an undesirable, but a dangerous quality in the sewer pipe. Judicious experimentation with powdered feldspar, salt, potash solution, or any fluxing agent would very soon establish the practicability and test the advantage of making the pipe vitrified throughout.

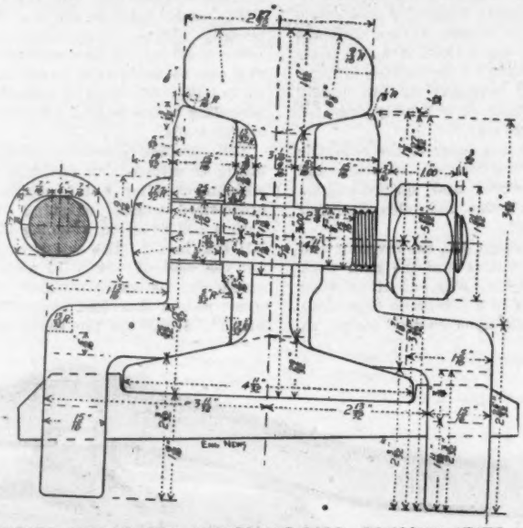
NEW TRACK FOR THE PRUSSIAN STATE RAILWAYS.

A new and heavier track has been adopted for the trunk lines of the Prussian State Railway system, and has been laid for a distance of about ten miles. From an article in the "Zeitschrift des Vereines Deutscher Ingenieure" we abstract the following particulars:

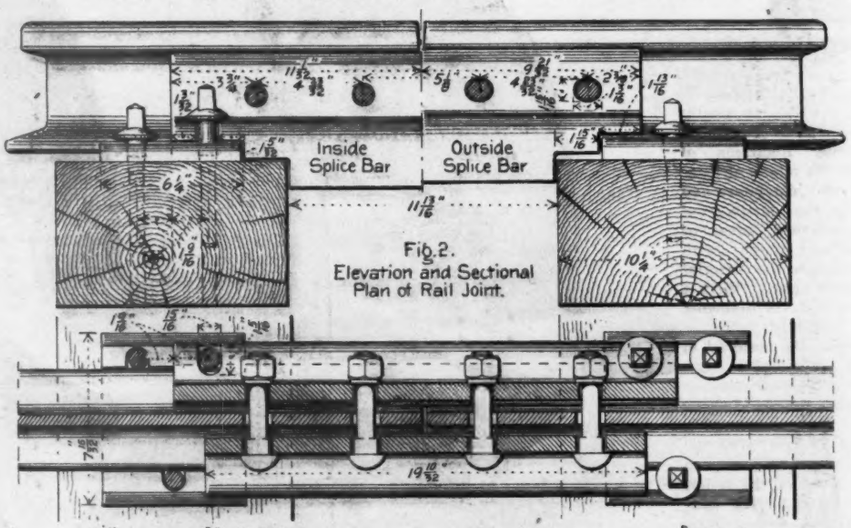
The rails weigh 82.65 lbs. per yd. and are 29 ft. 6 ins. long. The ties are of wood, and are 8.85 ft. long. The new rail section is of larger dimensions than the old form of section. The width of the head of the rail, Fig. 1, has been increased from 2 9-32 ins. to 2 27-32 ins., while the height is 5 7-16 ins., an increase of 5-32-in., and the width of base is 4 11-32 ins. The lower web of the splice bars is 15-16 in. thick, as compared with 23-32 in. in the old pattern. The bearing surfaces between the splice bars and the head and base of the rail have been increased 50% and 100% respectively by an increase in the section of the splice bars. The web of the rail has vertical sides, and its thickness has been increased from 7-16 in. to 9-16 in. The thickness of the base at the center line is increased from ¾ to 29-32 in. The rails are of mild steel having a tensile strength of 62,000 lbs. per sq. in. The splice bars are of mild steel or wrought iron, having a tensile strength of 48,260 to 57,150 lbs. per sq. in.

The arrangement of rail joints, Fig. 2, is similar to the older standard. The spacing of the ties on each side of the joint has been reduced from 15.75 ins. to 11.6 ins. in the clear. The outer splice bar has been reduced in length from 23.6 ins. to 19.3 ins.; the inner from 26.4 ins. to 22.05 ins. The weight of the splice bars is 30.5 lbs. and 33.2 lbs. respectively, an increase in weight of 6.62 lbs. each. The soft steel tie plates, Fig. 3, have a bearing surface with an inclination of 1 in 20, giving the rail an inward inclination in accordance with European practice to conform to the coned wheels. The thickness of the plate under the inner edge of the foot of the rail is ½ in., under the outer edge 22-32 in. Each plate weighs 8.82 lbs. The rails are fastened to the ties by screw spikes, the dimensions of which are given in Fig. 4. The obtuse angle of the thread seems a disadvantage, as the fiber of the wood is crushed by it, instead of being cut. The spacing of the ties is 33.2 ins. c. to c. with the exception of the joint ties, which are spaced 22.05 ins. c. to c. This spacing is adopted generally by the Prussian trunk lines and appears rather wide compared with the spacing used on the following railways:

Austrian State Railway, 1891	30.3 ins. and	31.0 ins.
Gotthard Railway, 1890	31.5 " "	29.5 "
Belgian State Railways, 1887	29.5 "	
Paris, Lyons & Mediterranean Ry., 1889	31.5 " "	29.5 "
Eastern Railway (France) 1889	29.5 "	



NEW STANDARD 82.65-LB. RAIL AND SPLICE BARS; PRUSSIAN STATE RAILWAYS.



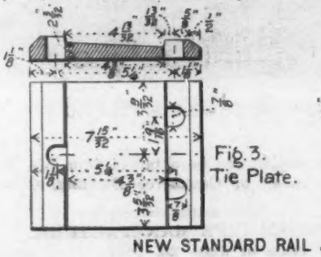


Fig. 3. Tie Plate.

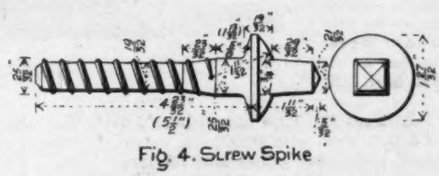


Fig. 4. Screw Spike

NEW STANDARD RAIL JOINT; PRUSSIAN STATE RAILWAYS.

The following table gives the comparative dimensions of the 82.65 lb. rail of the Prussian State Railways, the 85-lb. rail of the Baltimore & Ohio R. R. (Eng. News, July 18, 1891), and the 80-lb. rail of the New York Central & Hudson River R. R., (Eng. News, April 2, 1892).

	Prussian, 82.65-lb. ins.	B. & O. 85-lb. ins.	N. Y. C. 80-lb. ins.
Height	5 7/16	5	5 1/16
Width of base	4 11/32	5	5
" head, top	2 27/32	2 1/2	....
" " bottom	2 11/32	2 1/4	2 1/2
Slope of side of head	Vert.	Vert.	1/3 to 1
Depth of head	1 1/2	1 1/2	1 1/16
Height of web	3	2 7/8	3 3/8
Depth of base	11/32	1/4	7/16

Thickness of web	7/16	7/16	11/16
Height to center of bolt hole	2 1/4	2 5/8	2 3/4
Radius of top of head	8 1/8	12	11
" top corners of head	1/8	3/4	3/4
" bottom corners of head	1/8	1/4	1/4
Radius of top fillets	1/8	1/4	1/4
" bottom fillets	1/8	3/4	1/8
" corners of base		1/4	1/8
" sides of web	Vert.	Vert.	14°
Fishing angles of head and base	14°	13° 20'	14°

THE GOLDIE TIE PLATE.

One of the greatest of modern improvements in railway track has been effected by the introduction of metal tie plates, which add to the security of the rail fastenings and prevent the cutting of the tie, with the rotting of the tie and the insecurity which follow such cutting. These tie plates are a valuable complement to track material, involve only a small additional expense, and effect a very decided economy in track maintenance and tie renewals, besides materially increasing the safety of the track. One of the first tie-plates used in this country was the Servis steel tie-plate, brought out a few years ago by the Q & C Co. of Chicago, Ill., and now in use on a very large number of railways. It was illustrated in our issue of April 4, 1891. Metal tie plates of various forms are even more extensively used on railways in European countries and elsewhere than in the United States, and we have simply borrowed the idea from abroad.

The Goldie tie-plate illustrated herewith, is one of the newer forms, which has the advantage of a rib on the upper side, to resist the outward thrust of the rail and so prevent spreading of the track. There are two ribs of V section across the under side of the plate the sharp edges of which bite into the wood of the tie and prevent the plate and rail from slipping, thus adding to the security

The Goldie Tie-Plate.

of the track and preserving the accuracy of the gage. The upper rib also prevents the shearing of the outer spike and the wearing of its neck by the friction of the edge of the rail base. The plate is of rolled soft steel, ¼ in. thick, and is claimed to have been proved free from any liability to bend or buckle. It is 8½ ins. long and 4 to 6 ins. wide. The ribs not being at the edges of the plate it is claimed that the water will not be able to get into the grooves formed by them. This tie plate appears to offer many advantages in securing a good, safe and economical track, and, with the growing increase of traffic and cost of wooden ties there is an extensive field for its introduction. The plate is the invention of Mr. Wm. Goldie, the inventor of the Goldie steel spike, which was illustrated and described in our issue of Nov. 23, 1889, and both tie-plate and spike are manufactured by Dilworth, Porter & Co., of Pittsburg, Pa.

PROTECTING IRON TUNNEL ROOFS FROM CORROSION.

In the last issue of "Transactions of the American Society of Civil Engineers," Mr. James G. Dagron, M. Am. Soc. C. E., describes a method adopted by him of protecting from corrosion iron work used as a covering for tunnels. On the line of railway connecting the Baltimore & Ohio and the Philadelphia & Reading railways, in Philadelphia, the headroom in places is not sufficient to permit the use of an arch; and consequently the street above is supported on a buckle-plate flooring carried by tranverse iron girders.

Trains have been running through this tunnel since Sept., 1886, and in the winter of 1890-91 the attention of the author was called to the very serious corrosion of the iron work taking place under the combined action of gas and steam from locomotives. He was instructed to devise some means of arresting this action and proceeded as follows:

The iron work was thoroughly scraped and the girders were given two coats of asphalt paint. Skewback tiles were then placed in position on two continuous girders and a flat arch of hollow fire brick tiles was put in and each joint thoroughly sealed by cement mortar by a workman who was sent into the space between two transverse girders and the buckle-plates. After sealing the upper sides a 1-in. coat of cement mortar was applied to corrugations left on the under side of the arch for this purpose. The cost of the work, including the painting of the iron work, was $1.40 per lineal foot of arch, or $0.44 per sq. ft. of arch. Omitting the painting, the cost was $0.357 per sq. foot of arch.

Mr. Dagron says the tunnel is much freer from smoke since the arch was put in, as the girders held the smoke. The buckle-plates, which were galvanized, were not affected by the gas or steam. After four months there is no evidence of cracking in the 1-in. cement coating. It is less exposed to variation of temperatures than it would be outside the tunnel. In answer to a query as to why it would not do to apply the cement directly to the iron, it was stated that it would be much more difficult to make it adhere, and the direct heating of the iron in this case would be liable to cause trouble in expansion and contraction of the metal. It is supposed that the corrosive action of the gases, also, is largely due to the heat. A member said that galvanized iron would not answer as a protection, it had been tried and abandoned on his railroad, and its use for cornices in stations was also discontinued, as they were totally destroyed within two years.

AN INTERESTING RAILWAY DOCUMENT.

We have been shown lately the following interesting letter, written by Mr. Herman Haupt as early as 1853, while holding the position of the first General Superintendent of the Pennsylvania R. R. It anticipates so clearly many conclusions which modern experience has established as to reflect no small credit upon the foresight and perspicuity of the writer.

Philadelphia, Nov. 17, 1853.

I. E. Thompson, Esq.,

Dear Sir: I intended to call upon you on the evening of the day upon which you left town, to have some talk about railroad matters in general, but as it is difficult to find you free from other engagements, I have concluded to commit to paper a few remarks which you can pocket and read at your convenience.

I consider that the great objects of the construction of the Pennsylvania R. R. were to build up the city of Philadelphia, to promote the increase of trade and the general prosperity of the state, and at the same time to pay fair dividends to the stockholders.

From 8 to 10 per cent. per annum I consider a fair dividend, and this may be earned either by a small business at high rates or by a large business at low rates.

If the Pennsylvania R. R. Co. should refuse to carry a single pound of ordinary freight upon the road, and confine their business to passengers and express freights, I believe that dividends of eight per cent. could be paid to stockholders.

But such a policy would be injurious in the extreme to the commercial interests of Philadelphia, which require that every possible faculty should be afforded to trade, and every effort to bring upon the the road the largest business that it can accommodate, to secure these advantages, a system of low charges upon articles of great freight and little relative value is indispensable. In a word, the motto of the company should be a large business, low rates, and fair dividends.

At the same time it must be admitted that until the double track is laid, a large business cannot be accommodated, and we must be satisfied with higher rates and a much smaller volume. The principle of low rates is, in this case, applicable only to articles carried as back loading, or at the convenience of the company.

Where a road is in a condition to accommodate an increased tonnage, the cost of doing the increased business, and the profits resulting from it must be estimated, not by charging this business with an average of the expenses, but only with the increase consequent upon its carriage. If, for example, a road has an ordinary business of 300,000 tons per annum, and it is proposed to increase it 300,000 by the transportation of coal or some other heavy freight, the expenses and profits would be estimated by omitting all those of a fixed and permanent character, and estimating only those which are dependent upon or proportional to the tonnage.

In the maintenance of way department, an increased tonnage would not hasten the decay of cross-ties. It would require but a very small addition to the force of repair hands, and as to the abrasion of the rails, that only amounts to two cents per 100 tons per mile, according to experiments of British and Belgian engineers.

The motive power expenses will be increased in a smaller proportion than the tonnage, for many of the station expenses, superintendence, etc., will be fixed; it will be largely on the safe side to estimate the same per ton for the increase as for the original amount.

The repair of cars will be less than in proportion to the tonnage, as a small increase in shop room, mechanics and machinery will accommodate double the business.

So, also, in conducting transportation, a very large proportion of the expenses are permanent—station agents, printing, superintendence, clerks, etc. The only increase will be in a few brakemen, oil, etc.

When freight is carried at the convenience of the company, and used to fill cars that without it would run empty, the cost of accommodating the business is still less; in fact, it adds almost nothing to the cost on the company' own road.

The Baltimore & Ohio and the Reading R. R companies accommodate a large coal business. I have been figuring from their last reports to determine the cost of accommodating an increased tonnage upon these roads.

The cost of steam power in cents per ton per mile is, on	B. & O.	Reading.
	.331	.240
Car expenses, including conductors	.173	.160
Total	.504	.400

Of these expenses the repairs of coal cars were on B. & O., .021 cts.; Reading, .094 cts. The cost of car repairs has been four times as great on the Reading R. R. as on the B. & O., which may be explained from the fact that the cars of the Baltimore Road are better constructed and more nearly new. The Reading cars have very large wheels and small axles.

From these results I am led to conclude that if the Pennsylvania R. R. Co. had a double track road under one management, they could transport coal at a cost of about one-half cent per ton per mile without actual loss, and lumber at 9 mills per 1,000 ft., and that a charge of one cent per ton per mile on an increased business of 500,000 tons carried 200 miles, would pay a net profit of 5% on $10,000,000, forming a most desirable increase to the revenues of the road, if we are in a position to accommodate it, which, of course, we never will be while that incubus, the state tax, continues.

But even if this business did not pay a dollar of the revenue, my opinion is that it would be to the interests of all parties that it should be accommodated, as it would give employment to a large population, and stimulate many other important interests.

At this time it is not expedient to encourage a large business by low rates. We are not ready for it, and cannot be before we have a double track, but we should increase our revenue by carrying at convenience, and it should also be observed that even if low rates should permanently be fixed upon coal and lumber, it would be a year or more before the stimulus of this reduction could lead to a sufficient increase to embarrass our transportation, by which time we would be prepared for it.

On the Pittsburgh end of the road, a local train could be run without interfering with other business, and with profit at 1¼ cts. per ton per mile, including cars, and exclusive of state tax. The cars could be kept in repair at a cost of two cts. per ton for 20 miles. Lumber could be carried from Tyron to Philadelphia, say, 230 miles, on a continuous road, without tax, at $3.50, and pay a reasonable profit if the handling is done by shippers.

These remarks are of a general character, and irrespective of any private interest or bias whatever. They exhibit what I believe to be the true position of affairs, and under the influence of such opinions I have encouraged those who have consulted me to invest capital in coal and lumber operations, and make expensive improvements. So clear to me did the true policy and interests of the company appear, that I could not suppose it possible that a different view would be taken by those who would have the management of the road. Mr. L., however, thinks that the cost of transporting heavy tonnage is not less than 1¼ cts. per mile. I am satisfied that he is wrong, but give him credit for a disposition to make all that he can for the company. The policy, however, is calculated to reduce the business within very narrow limits.

Upon the question of the propriety of furnishing cars by the company, I am clear in the opinion that it is to the interest of the company to furnish cars for any regular and permanent business that is done upon the road. The expense of cars for a large business, and for long distances, is too great for individuals, and if they are required to furnish them the business will be very limited. I have no idea that the coal business of the Reading or Baltimore roads would be as it now is if the companies had refused to furnish cars, besides the price charged for them can always be sufficient

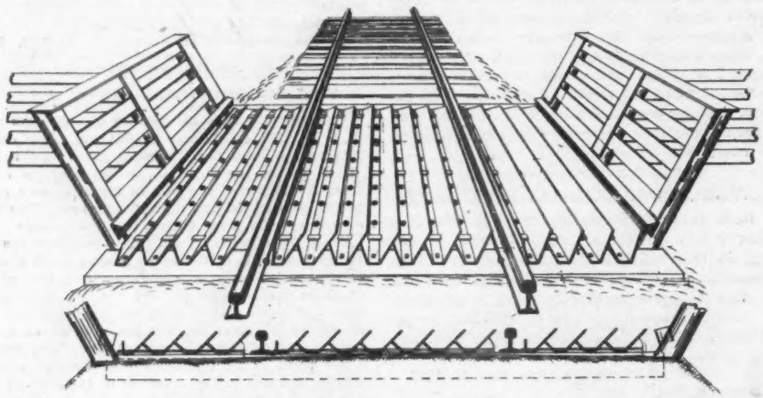
to allow a large profit, and it is out of the question for individuals to establish repair shops to keep their cars in order, without which they will be at the mercy of any one who chooses to charge exorbitantly for repairs. It is proper, however, to require that parties to whom cars are furnished, should keep them constantly employed if regular transportation is furnished.

This letter has been written, not as an officer of the company, but as an individual. I have, as you know, no connection in any way with transportation or regulation of tolls, and therefore could see no impropriety in defining my position, and in giving an expression of opinion.

Yours truly,
H. Haupt.

THE NEW STANDARD CATTLEGUARD, NO. 5.

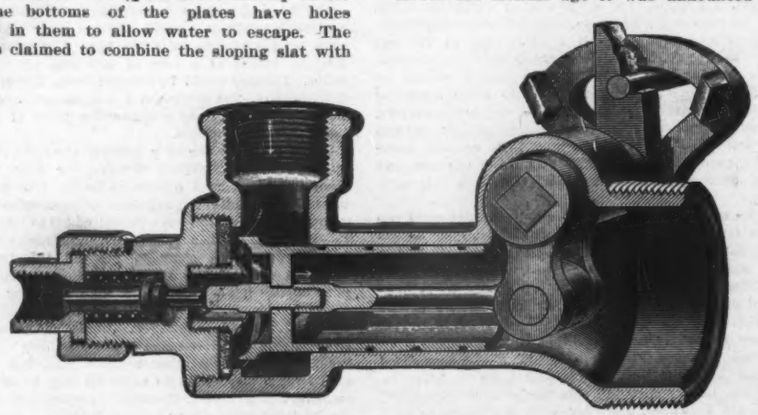
We have from time to time illustrated a number of forms of surface cattleguards, and this week present a cut of a new iron cattleguard designed by Mr. B. Wolhaupter, C. E., manager of the Standard Cattleguard, Chicago. It is a modification of and improvement upon his original standard cattleguard No. 1, illustrated in our issue of Jan. 9, 1892, and has been designed to meet the requirements of some roads for a cheap but efficient cattleguard. Like the No. 1 pattern it is composed of longitudinal sloping slats, but the upper edge of each slat has no angle or bend, and the lower edge is bent up to form a supporting ridge for the next slat. By this means all high cross pieces or inverted pieces are rendered unnecessary and are dispensed with, thus leaving a clear passage for anything trailing from a train. The sections are firmly secured together by T or angle irons passing through the bottom and projecting not more than ½ in. above the top of the ties. The bottoms of the plates have holes punched in them to allow water to escape. The guard is claimed to combine the sloping slat with a vibrating footing which together will effectually turn cattle, etc. The guards can be galvanized for a slight additional cost.



STANDARD SURFACE CATTLEGUARD NO. 5.

AN IMPROVEMENT IN STEAM TRAPS.

The accompanying cut shows an improvement in steam valves for return steam traps just placed on the market by the Curtis Regulator Co., of Boston. It is essential to the correct operation of a return trap that the steam valve shall be tight. In the trap illustrated the steam valve seats against a removable disk of Jenkins composition. The valve and seat can be removed for examination without breaking any gasket joint or turning any bolt. The steam valve is balanced and single seated and the air relief valve is automatic, opening only when the steam valve is closed. The advantages of return traps in saving the heat in the water of condensation and returning it to the boiler are so obvious that their use is rapidly increasing; and any improvement in their durability and simplicity is of much importance.



ARRANGEMENT OF STEAM AND AIR VALVES IN THE CURTIS RETURN STEAM TRAP.

THE PROPOSED NEW TUNNEL THROUGH THE PALISADES OF THE HUDSON RIVER.

In our issue of June 2, 1892, we noted briefly a proposition to construct a tunnel through the Palisades on the west shore of the Hudson River. Little has been heard of the project since that time, however, owing to the quietness with which the work has been carried on, and it is only within the last week that anything sufficiently definite has been made known worthy of being regarded otherwise than as mere rumor. Nevertheless, active work preparatory to the construction of the tunnel has been in progress for some time. We have, therefore, thought it of interest to give a short summary of the principal facts and rumors connected with the enterprise. As, however, the company refuses to give any information in regard to its plans, except in so far as to state that the tunnel will be built, they cannot be substantiated.

About six months ago it was announced that surveyors for the Canadian Pacific Ry. Co. were running a line from Albany, N. Y., along the base of the Catskills, to Suffern, Rockland Co., through the Ramapo Mountain west of the New York, Lake Erie & Western R. R., which it crossed between Allendale and Ramseys; thence south through the thickly settled Saddle River and Paramus valleys to the New York, Susquehanna & Western R. R., which it struck between Rochelle Park and Maywood, about two miles west of Hackensack and five miles east of Paterson. The engineers performing the work were reticent as to their object, but about the time they departed there was filed in the County Clerk's office at Hackensack a certificate of incorporation of the Hudson Docking & Terminal Co., composed of Joseph H. Ramsey, Robert J. S. White, William S. Carman, Cornelius B. Harvey, David A. Pell and John J. Cone. This company declared its purpose to be to build, own, use, or rent railroads, steamboats, docks, tunnels, etc.

Shortly after this company was announced as having a corporate existence, there were rumors that a tunnel was to be built through the Palisades from Fairview, which is near "The Island," and Edgewater, south of Fort Lee. Several large tracts of land with extensive water fronts were bought between Edgewater and Bull's Ferry by the Hudson River Railroad & Terminal Co., at prices ranging from $500 to $1,000 an acre, which were considered very liberal figures. Recently a board of commissioners appointed to condemn lands for the same company west of the Palisades, made awards to several parties and the company also paid the Bergen Turnpike Co. $2,000 for crossing its roadway at Fairview.

For about two months it is stated that there have been large gangs of men busy on the preliminary work at both ends of the tunnel, establishing a plant with the most improved machinery for carrying forward the enterprise as expeditiously as possible. At Little Ferry Junction, near Bellman's Creek on the island, thousands of piles have been driven in the meadow, and a track is being laid beside and connecting with the New York, Susquehanna & Western R. R. The track is to be raised so as to cross the New York, Susquehanna & Western R. R., the West Shore, and the Northern R. R. of New Jersey, on heavy iron bridges.

As all the business of this enterprise has been carried on in the most quiet manner possible, and the officers of the company decline to give information, little beyond rumor is known of the real backing of the enterprise. One report is that the Canadian Pacific Ry. Co. is back of it, and will use the New York, Susquehanna & Western tracks from Maywood to Little Ferry. But no effort has been made to acquire right of way for the line surveyed through the Saddle River and Paramus valleys for the connection. Another rumor is that the Pennsylvania R. R. Co. is the principal party interested. It is well known that there is not sufficient capital in the New York, Susquehanna & Western R. R. Co. to carry forward so expensive an undertaking.

It is stated that all the legal work attending the transfer of property to the Hudson River R. R. & Terminal Co. in Bergen County, has been performed by New York, Susquehanna & Western and Pennsylvania R. R. lawyers.

According to the information given out by the officers of the company the tunnel will have its Hudson River mouth opposite 104th St. in New York city; will be one mile long, and that the railway including the tunnel's length, will be three miles long. It is also stated that $500,000 has been spent in construction, so far, and that the whole cost is estimated at $2,000,000. The work is expected to be finished by Jan. 1, 1894.

The Strowger telephone attachment, dispensing with the "hello" girl at the central office, has been put on trial in La Porte, Ill. The method is simple enough to the subscribers. Under the ordinary Bell telephone on a shelf is a board with three keys, marked hundreds, tens, units, and a release button. To be put in communication with any number, say 123, he pushes No. 1 key once, No. 2 twice and No. 3 three times. If the line is clear this operation automatically puts him in electrical communication with the party sought. The means is not so simple as the method as far as the central station mechanism is concerned. Although there are only 75 telephones in the La Porte circuit, Mr. A. B. Strowger, the inventor, claims that 6,000 wires can be successfully run from one 5-in. central station disk. The patent is owned by the Strowger Automatic Telephone Co., of Chicago, Ill., incorporated in 1891 with $5,000,000 capital. Mr. M. A. Meyer is President.

The work on the Desague drainage tunnel, for the valley of Mexico, is progressing very satisfactorily. Mr. Fred. W. Abbot, Chief Engineer, writes us that whereas he lately notified us that a record had been made of 346.4 ft., bottom heading, driven in one

month at No. 17, this record has been beaten. In October last a record was made of 13.87 ft. per day, equivalent to 416.2 ft per month. This heading was timbered with settings every 3 ft., and palled all around. The ground was not very good, being a sort of soapy clay called "jaboncillo." It is treacherous and swells considerably when exposed to the air. Of the total length of the tunnel, 32,800 ft., about 22,960 ft. will be opened up by heading by the end of this year, and about 19,680 ft. of tunnel will be completed.

The docks at Southampton, England, have been acquired from the dock company by the London & Southwestern Ry. Co. These docks were described in our issue of Oct. 6, and will be used by the Inman and Red Star steamship lines, which will make Southampton, instead of Liverpool, their English port after March, 1893.

The height of Mt. St. Elias, in Alaska, has been estimated or measured 11 times since 1876. La Perouse, in that year, made it 12,672 ft. high above the sea, and in 1791 Malaspina increased this height to 17,851 ft. Later authorities varied between 16,758 ft. and the measurement of 1791 until the English Admiralty chart of 1872 reduced the figure to 14,970 ft. The U. S. Coast Survey, in 1874, made it about 19,500 ft., and the U. S. Geological Survey and Nat. Geographic Society made it 15,350 ft. in 1890, and about 18,100 ft. in 1891. Mr. M. B. Kerr, topographer of the Mt. St. Elias Expedition of 1890, says, in a paper read before the Technical Society of the Pacific Coast, he believes that the true height of this mountain is about a mean of the several measurements, or about 16,690 ft. The difficulties in accurately fixing this height seem to lie in the refraction, the long open sides of the triangles and the broken nature of the ground.

Additional docks, a deep water pier and more extensive railway yards and sheds are to be established at Avonmouth, on the Bristol Channel, England, to increase the facilities for ocean steamship traffic. The Avonmouth docks are owned by the city of Bristol, and the city has approved a bill to be presented before Parliament authorizing the expenditure of $5,000,000 for the new works, additional land, etc. Some of the citizens and shipping men, however, wish to revive the project for dockizing the river Avon, so that large steamers can go up to the city without waiting for the tide.

Car heating is again being agitated in some of the English railway papers. Already some of the trunk lines running from London to the north have had satisfactory results from their experiments with steam heating. The suggestion is made that as the port of Southampton is to be used by some transatlantic steamship lines it will be an enterprising move on the part of the London & Southwestern Ry. to equip the trains running between Southampton and London with efficient heating and lighting systems.

Sleeping cars are apparently coming into more general use on British railways. The Great Western Ry. has attached sleeping cars to its night mail trains east and west between London and Milford, 286 miles, using short cars built at its own works instead of Pullman cars. The company will also build more of the corridor cars illustrated in our issue of April 28, of which they have now about 25. The Great Northern Ry., of Ireland, now runs sleeping cars on the night mail trains between Dublin and Londonderry, 165 miles, for which a nominal charge is made in addition to the regular first-class fare.

A tunnel 3½ miles long has been completed in England. It is the Totley tunnel on the Dore and Chinley branch of the Midland Ry., which crosses a range of hills and has some very heavy works. About 1,000 men have been engaged on the tunnel for four years, and great difficulties have been met with in heavy work and the presence of great quantities of water. There are four shafts, all within three-quarters of a mile from one end, but ventilating shafts will be sunk later. The top of the hill is 750 ft. above the tunnel, and 1,360 ft. above the sea level. The tunnel is straight, and has grades of 1.33% and 2% from one end, and 0.1% from the other end. It is 27 ft. wide and 20 ft. high from rail level to crown, and has a double track. About one-third of the brick lining remains to be done. The work has been done by compressed-air drills, and the explosive used was gelignite.

The U. S. cruiser "Olympia" was launched at San Francisco, Cal., on Nov. 5. The Bureau of Steam Engineering, at Washington has completed plans and specifications for the engines and boilers of battleship No. 1, the largest modern warship yet built by our Government, its displacement being 11,250 tons. This new vessel will have triple-expansion engines of 11,000 HP., which, at 112½ revolutions per minute will give her a speed of 16 knots per hour. Three double-ended main and two single auxiliary boilers will furnish steam at 160 lbs. pressure, and the two smoke stacks are to be 100 ft. high, doing away with "forced draft" in ordinary cruising.

The Manhattan Elevated Railway, in the year ending June 30, 1892, reports as follows upon its passenger traffic, comparing it with 1891:

	1891.	1892.
Second Avenue line	32,574,091	34,294,356
Third " "	77,978,822	79,856,344
Sixth " "	69,254,641	74,092,511
Ninth " "	19,520,387	20,027,474
Total, Manhattan	199,327,941	208,270,681
Suburban branch	1,417,777	6,851,894
	200,745,718	215,122,575

The financial report is as follows for the same period:—

	1892.	1891.
Gross earnings	$10,908,578	$10,174,935
Operating expenses	5,964,888	5,608,021
Net earnings	$4,943,689	$4,566,914
Charges	1,963,743	1,916,080
Balance	$2,979,946	$2,650,834
On stock	9.93%	8.83%
6% dividends	1,800,000	1,680,000
Surplus	$1,179,946	$970,826

The Niagara Falls Power Co. has made its first contract to furnish power with the Niagara Falls Paper Mills Co. The price agreed upon is $8 per HP. per year. Mr. G. B. Burbank, a prominent official of the power company, says in an interview in the Buffalo "Inquirer" that this contract cannot be taken as a general basis; subsequent contracts must be governed by their own peculiar exigencies. At present, he says, the company can only guarantee to sell the power at least one-third lower than it would cost to operate the same machinery by steam, and in some cases it might be one-half cheaper, where the horse power mounted into the thousands.

American tinplate production is reported to have increased as follows:

Three months ending with Sept., 1891	826,922 lbs.
" " " " March, 1892	3,200,225 "
" " " " Sept. 1892	10,952,725 "

In the meantime the quarterly rate of importations in 1892, has been as follows:

At rate of September, 1892	128,630,178
At rate of 9 mos., ending with Sept., 1892	158,842,405

The importations during September, 1891, were at less than half this rate, and for the 9 months ending with September, 1891, at nearly double this rate, owing to the disturbing effect of the change of tariff in that period.

Work on the Lake St. elevated railway, of Chicago, has been resumed, and is said to be in fair way to be carried to completion. Mr. J. Q. Baird, who resigned as Chief Engineer in May last, and resumed his private practice as General Manager of the Chicago Engineering & Surveying Co., has been re-engaged, with his entire force. Mr. Baird informs us that about 1½ miles of iron-work have been erected, and that one-half mile of track has been laid. About 75 men are at work on the superstructure. The iron has all been furnished by the A. & P. Roberts Co., of Philadelphia. About 3 miles of foundations are in, and 1½ miles more are to be put in at once. This will extend the line to Crawford Ave., and make a total of 5 miles of foundations already in. The entire length of the line, when completed, will be 10 miles. It is now expected to open one section of the line by May 1, 1893.

A tunnel-measuring expedition has been started out by the Pennsylvania Railway Co. The purpose of this inspection is to fix the exact width and height of all tunnels on the line of the road, so as to exactly establish limiting points of car dimensions. The inspection car is especially fitted for this work. A template carries pins, 3 ins. apart, set to some standard dimension, and whenever any of these pins strike an obstruction, the train is stopped, and a measurement is quickly taken. This is the first thorough inspection of this character we have heard of, though the necessity for such exact knowledge is constantly apparent on every trunk line.

A gun-making syndicate, with $2,500,000 capital, has been formed in Hartford, Conn., for the manufacture of Hotchkiss and Gardner machine guns and gun-making tools, and machinery generally. The West Side shops of Pratt & Whitney form the basis of the syndicate as far as plant is concerned.

The Topeka, Kan., power dam, for which so much has been claimed in the way of cheap power, is fully and clearly reported upon by Mr. Lewis Kingman, City Engineer of Topeka. He says that the dam, with its headgate, raceway station, turbines, dynamos, motors, etc., would cost $799,803. He says the reservoir formed would hold 205,400,000 cu. ft., and with the minimum amount of water running, this would fill up in 52 hours. This represents only a daily storage, and 10 or 12 hours' use; or for a steady day and night run there is only 1,100 cu. ft. per second. The low-water power is about all that can be sold, and the cost of the 1,398 HP., at the mouth of the raceway, would be $572 per HP. Mr. Kingman finds that to meet this cost the rate of charge per horse-power without profit for 10 hours per day for one year would have to be $35.43. This, he says, does not meet the requirements of cheap power. In making this deduction he assumes 80% efficiency at the wheel, and a further loss of 20% in transmission of power by wire. Taking into consideration the fact that the dam leaks some, and that some of the power-users only run in the daytime, he says that 800 HP. is about all that could be disposed of. Mr. Kingman concludes by asking the citizens of Topeka to take warning by past experiences, where the expected return upon investments did not materialize.

A high-pressure joint for salt glazed vitrified pipe has been invented by Mr. C. C. Merrill, Manager of the Elsinore Pottery Works, of Riverside, Cal. He makes the pipe perfectly straight with abutting ends, and inserts an iron or steel collar 3 ins. broad, 1½ ins. into a recess in each pipe-end. Asphaltum prevents rust and this pipe-joint is claimed to have withstood a pressure of 75 lbs. without leaking a drop, in a recent test.

Some brass condenser tubes in the U. S. cruiser "Baltimore," after being in service for a year or more were found to have experienced a peculiar change. In many places the metal was changed to almost pure copper, of a spongy texture, the zinc have completely disappeared. An investigation showed the probable cause of the failure to have been an electrolytic action between the tin lining of the tubes and the brass, the sea-water circulating through the condenser forming the electrolyte. Had the tin coating remained perfect, no corrosion would have resulted; but the mud and grit carried in suspension through the condenser cut away the tin coating in spots, and it was at these spots that the change of the metal occurred. It was concluded that if the tubes had not been tinned at all they would have remained intact.

Two pumps made of hard rubber, each having a capacity of 4,500 gallons per hour against a head of 30 ft. were recently built at the Enterprise Rubber Works at College Point, L. I., for the U. S. Fish Commission. The pumps are to be used for circulating the water in the great salt water aquarium at the World's Columbian Exposition. Hard rubber was used instead of metal for all surfaces exposed to the salt water, since even a slight corrosion of the metal might in time poison the water after repeated circulation through the pump.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

LAKE ERIE & WESTERN.—The officials of this company are reported to be considering the extension of the Minster Branch to Piqua, O.

MUNCIE BELT.—Rapid progress is being made on this 9-mile belt railway at Muncie, Ind.

BUFFALO, ROCHESTER & PITTSBURG.—The grading is practically completed on the line from Clearfield to Jefferson Line, Pa., 27 miles, and it is intended to begin tracklaying by Dec. 1.

PENNSYLVANIA.—The Cambria & Clearfield R. R. has recently placed under contract three short coal branches. They are 3 miles, 2.2 miles, and 1.2 miles long, respectively. Work is light, and is being pushed by a large force of men.

WESTERN MARYLAND.—The grading of that part of the roadbed of the new line between Spring Grove and Porter's Siding, Pa., has been completed, and a large force of workmen are now engaged in placing the ties in position preparatory to laying the rails. Work on the eastern end of the road between Spring Grove and York, Pa., is also being rapidly pushed forward before the setting in of cold weather, and the grading on that part will also be shortly finished, when the work of tracklaying will at once be commenced and vigorously pushed to completion. It is expected that trains will be running through to York from Hanover by New Year's Day.

BALTIMORE & DRUM POINT.—A press dispatch from Baltimore, Md., says: "Work on the Baltimore & Drum Point R. R., which was suspended about a year ago, will soon be resumed. The men into whose hands the road passed at the receiver's sale last April are practically the owners of all the bonds issued by the company. They are Edward Lauterbach, of New York, and Frank R. Biedler, of this city. The principal work done on the road was the grading of 50 miles. The Annapolis, Washington & Baltimore R. R. is the nearest line to the finished part of the Drum Point road, and less than three miles would have to be built to make connection with the Annapolis, Baltimore & Washington. Over a half million dollars had been spent upon the road, when work was stopped, and about $750,000 more will be required to finish it."

PHILADELPHIA & READING.—The residents of Bristol, Pa., are working to secure the extension of the Philadelphia-Frankford branch, now under construction for six miles, to that place.

WILKES BARRE & EASTERN.—It is stated that work is now in progress along the entire line from Wilkes Barre to Stroudsburg, Pa., 60 miles. It is expected that the grading will be completed and a considerable track laid by Jan. 1, 1893.

OTTAWA & GATINEAU VALLEY.—Tracklaying is now in progress on the section of the railway between

Kazubasua and Farrelton, P. Q., and it will be opened for traffic soon.

Projects and Surveys.

NEW YORK & MASSACHUSETTS.—A press dispatch says: "The talk of the construction of the New York & Massachusetts R. R., has been revived by its advocates, since the consolidation of the Philadelphia & Reading and the Boston & Maine. The length of this road, as projected, from the Poughkeepsie Bridge to Chicopee, Mass., will be about 110 miles, which is considerably shorter than any other connecting line between the coal fields and Massachusetts. Thirty-five miles of this road are already in operation from the Poughkeepsie Bridge to the Massachusetts line. The proposed route is to the Housatonic Valley, where it will connect with the Housatonic R. R., then running east through Tyringham, Otis and Granville to Westfield, where it will connect with the Boston & Albany and the Northampton Division of the New York, New Haven & Hartford; from there to Chicopee, where it will connect with the Connecticut River R. R. and the Central Massachusetts. The cost of the road with its equipment is estimated at about 1,900,000. The advantage claimed for this line is on account of its being so much shorter than any of the competing lines."

BEAVER MEADOW, HAZLETON, MAHANOY & SHENANDOAH.—An official writes us that this proposed Pennsylvania railway will be 25 miles long, and that no surveying will be done until next spring. Secy., A. R. Blakeslee, Delano, Pa., and Treas., P. J. Ferguson, Shenandoah, Pa.

BARE ROCK.—Chartered in Pennsylvania to build a railway from Bare Rock to a point on the S me s t & Cambria Branch R. R. Pres., John Murdock, Johnstown, Pa. Principal office Johnstown, Pa.

LOCK CITY.—This company has been chartered in New York to build a railway eight miles long, at Lockport, N. Y.

Southern.—Existing Roads.

NORFOLK & WESTERN.—This company will, it is stated, build a branch from Coeburn, Va., to Fuller's Gap.

MEMPHIS & CHARLESTON.—The contract for building the masonry for the long bridge across the Tennessee River, at Florence, Ala., has been let to Neely & Smith, Florence, Ala.

MIDDLE GEORGIA & ATLANTIC.—It is announced that this company has secured the money necessary to complete the partly graded line from Covington to Machen, Ga., 25 miles. Ch. Engr., Arthur Pew, Savannah, Ga.

WILMINGTON, ONSLOW & EAST CAROLINA.—Ch. Engr., H. A. Whiting, Wilmington, N. C., writes that a force of about 250 men are now at work on the extension from Jacksonville to New Berne, N. C. The extension is 38 miles long, and about 15 miles are now graded, and one mile of track laid. It is intended to have the line in operation some time next spring. The maximum grade is 1% and the maximum curve is 1°. Thos. A. McIntyre, 212 Produce Exchange, New York City, is the contractor.

TENNESSEE MIDLAND.—The syndicate of St. Louis capitalists, owners of the Paducah, Tennessee & Alabama R. R., who in May last purchased from the Virginia Construction Co., of Richmond, the Tennessee Midland Ry., extending from Memphis, Tenn., 135 miles in the direction of Nashville, have completed the construction of the 30-mile connection between Hollow Rock and Lexington, Tenn. The new owners are now perfecting arrangements for the speedy completion of the Tennessee Midland to Nashville. The citizens of Davidson County, in which Nashville is situated, will, on the general election day, Nov. 8, vote on a proposition to subscribe $350,000 to secure its completion to that point. Many of Richmond's (Virginia), most prominent capitalists are interested in the mortgage securities of this company, it having been originally projected and organized by the late T. C. Leake, Jr., of that city. Col. A. S. Buford and Mr. R. L. Traylor are the Richmond representatives on its board of directors.

CHARLESTON, CLENDENNIN & SUTTON.—Work on the first 20-mile section is well advanced. About 16 miles have been graded and 12½ miles of track laid. It is expected to have the entire 20 miles completed by Dec. 31.

Projects and Surveys.

GREENVILLE & PEVEY.—Preliminary surveys have been completed for a railway 21 miles long from Greenville to Pevey, Fla., and locating surveys are now in progress. The road is projected to open up phosphate mines, and construction will begin immediately. Ch. Engr., J. F. Le Baron, Jacksonville, Fla.

FRANKLIN & NEWNAN.—The construction of a railway from Franklin to Newnan, Ga., is being discussed.

CARTERSVILLE & BENTON.—A company is being organized to build a railway from Cartersville, Ga., to Benton, Tenn. Samuel Carter, of Cartersville, Ga., is interested.

HARRIMAN & PORT ROYAL.—Pres., Alfred E. P. Rockwell, Harriman, Tenn., writes us that surveys are nearly completed for this proposed railway from Anderson, S. C., to Harriman, Tenn., 220 miles. The maximum grade is 65 ft. per mile, and the maximum curve 8°.

Northwest.—Existing Roads.

DULUTH TRANSFER.—We have received the following details concerning this railway from the Calumet Construction Co., Day K. Smith, Pres., and Gen. Man., which is operating and constructing the road: "The Duluth Transfer Ry. is being built as a terminal and switching road for the purpose of supplying terminal facilities to new roads entering Duluth and for the purpose of assisting in developing the business interests at the head of the lakes. Several large industries are already located on our line, including saw mills, stone yards, two important iron works industries and the large coal dock of the Pennsylvania & Ohio Coal Co. At the beginning of the year we had 3½ miles of track all told. On Dec. 1, 1892, we shall have 9 miles of main track and 4 miles of siding and private tracks. Construction as far as track laying is concerned will probably then cease for the winter, but will be resumed as early in the spring as is practicable. Our line extends up and down the lake front, St. Louis Bay and St. Louis River. We now have connections made with the Northern Pacific and the St. Paul R. R. companies and expect on Dec. 1 to have completed a connection with the Duluth & Winnipeg and through it with the Duluth, Mesaba & Northern Railway."

NORTHERN PACIFIC.—This company is making preparations to extend its terminal facilities in Duluth, Minn.

DULUTH, SOUTH SHORE & ATLANTIC.—About 27 miles of track have been laid on the 40-mile extension from Iron River to Superior, Wis. Twelve miles have been laid from Atlantic Junc. east and 15 miles from Iron River west.

ST. PAUL & DULUTH.—This company has begun work on the construction of 8 miles of new terminals extending from Rices' Point to the Union Depot in Duluth.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—It is reported that right of way is being secured for an extension from Sioux City to Le Mars, Ia.

PHILLIPS & LA CROSSE.—Geo. E. Anthony, Phillips, Wis., President, writes us that tracklaying will begin Nov. 20 on this line, from Phillips to Kennon, Wis., 15 miles. The work is being done by the company. Ch. Engr., H. E. Clark, St. Paul, Minn.

Southwest.—Existing Roads.

MISSOURI, KANSAS & TEXAS.—Grading on the Houston, Tex., extension is completed from Boggy Tank to Sealy, Tex., 27 miles, and 13 miles of track are laid. Between Sealy and Houston, Tex., work is being rapidly pushed.

CHOCTAW COAL & RY. CO.—Arrangements are being made to take this railway out of the hands of the receivers, and complete it between South McAlister and El Reno, Ind., Ter.

KANSAS CITY, ELDORADO & SOUTHERN.—A press dispatch says: "The capitalists interested in the Kansas City, Eldorado & Southern R. R. have made arrangements to push work on that road. Consequently, work will begin in a short time, and, it is said will be pushed until the road is completed. The road will be built from Eldorado to Aurora, Lawrence County, a distance of 75 miles, and from Eldorado north to a connection with the Kansas City, Nevada & Fort Smith, making a road 116 miles long."

GREENFIELD & NORTHERN.—The Kansas City "Times" says: "The managers of the Greenfield & Northern R. R. are actively pushing the work of construction on the road. Surveyors are at work north of Greenfield, Mo., laying a route through Cedar Co., to a connection with a Kansas City road. Of the routes that have been gone over, two only meet with favor. The first is through Stockton, the county seat of Cedar Co., to a connection with the Kansas City, Osceola & Southern at Osceola, Mo. The other route is from Stockton north through Arcola and El Dorado Springs to connect with the line now being built from Eldorado Springs to the Missouri, Kansas & Texas Ry. One of these routes will be selected and either would bring passenger trains into the depot at Second and Wyandotte streets. The people of Eldorado Springs have been endeavoring for several years to secure direct connection with Kansas City, a committee from that city having appeared before the Commercial Club on several occasions asking its influence to secure this connection."

Rocky Mt. and Pacific.—Existing Roads.

GREAT NORTHERN.—It is expected that the gap between the ends of track east and west of the Cascade Mts. on the Pacific Extension will be closed probably by Dec. 1, and surely by Dec. 10. The total length of the extension from Kalispel, Mont., to Everett, Wash., is 557.9 miles, of which about 300 miles will have been completed this year.

WASHINGTON & COLUMBIA RIVER.—Pursuant to an order of the United States District Court for Oregon, the property of the Oregon & Washington Territory R. R. Co., which has been in the hands of a receiver since last December, has been transferred at a foreclosure sale to a new corporation known as the Washington & Columbia River Ry. Co. C. B. Wright, of Philadelphia, is the almost exclusive owner of the new company, holding all its bonds, amounting to $4,175,000, and nearly all its capital stock of $3,000,000. W. D. Tyler is president and general manager of the new company.

RIO GRANDE WESTERN.—A press dispatch says: "A railroad man just returned from a trip through Nevada and Utah states that a force of 2,000 men is at work in the Deep Creek region of Western Utah building a standard gage road. He says these men were advertised for and engaged by the Rio Grande Western people at Salt Lake. Evidently this is the long projected and much talked of Rio Grande Western extension to the Pacific Coast."

SOUTHERN PACIFIC.—In accordance with a vote of the Board of Directors last September, this company has filed amended articles of incorporation. The object of the new articles is to enable certain lines omitted in the original incorporation to be included. Provision is also made for the construction of 36 different lines, some of which are merely small branches or switch lines, but one or two are important. Among these important lines is one commencing at Montpelier, Cal., and running east and north to Yosemite Valley. This will be the first railroad to penetrate the valley, and it is stated that the route has been surveyed, presenting few or no engineering difficulties or heavy grades. Another road will run to the Calaveras Big Trees. It will commence near Stockton, Cal., proceeding eastward by way of Milton, 25 miles, with an extension in a general northerly direction to the Big Trees. There will be a branch from Altarville northwest to Valley Springs in Calaveras Co., making in all about 80 miles of road. Other new lines of interest are as follows: From San Francisco to San Bruno; from Kings City east to Lewis Creek, Monterey Co.; from Paso Robles southeast to Carisso Plains, 56 miles; from San Luis Obispo southeast to a point on Santa Ynez River, about 80 miles; from a point in a southeasterly direction by way of Lompoc, Santa Ynez Mission, 35 miles; from San Buenaventura east by way of Hueneme Plains and San Fernando Valley to Los Angeles, 70 miles; from Santa Monica west to New Wharf, west of Santa Monica canyon, three miles; from Ontario by way of Chino and South Riverside to Elsinore, 51 miles; from San Bernardino south to South Riverside, 28 miles; from Redlands Junction east to Yucaiba Valley, 15 miles; from San Bernardino southeast to Motor Junction, 8 miles; from Colfis east to Fresno, 16 miles; from Mendosa southeast to Lokern, Kern Co., 110 miles; from Lokern to Rio Bravo, 15 miles; from Stevens, Kern Co., east to Bakersfield, 15 miles; from Lokern southwest to Asfalto, 10 miles; from Fresno northeast by way of Pulaski, 75 miles to a point near the head waters of the San Joaquin.

Projects and Surveys.

CANADA & WESTERN.—The Helena, Mont., "Journal" gives the following description of the objects of this company whose incorporation was noted some weeks ago: "It appears that Frank Bakeman and a party of Chicago capitalists who have made a study of railroading in the Northwest appeared before the British Columbia legislature at the last session and secured a charter for a road to be built over the route originally laid down for the Canadian Pacific, together with immensely valuable land subsidies. The company has now been thoroughly organized, a construction company formed and a party of surveyors put in the field. By next year active construction will be begun and the arrangements completed for a transcontinental line. The railway is to be built in two great divisions. The first is on Vancouver Island from Victoria north to Fort Rupert, the northern extremity of the island. This will open up the undeveloped but rich coal fields lying along the mountain range. The line will extend north along the east side of Duluth, on Duncan's Bay, Seymour Narrows, where transfer boats will carry the trains to the mainland division. The divisional yards will be built at Duluth. Going on from there a line will probably be built across the island through the Campbell River pass to a harbor on the west coast some 200 miles north of Victoria. Here there is a probability of a big shipping port being built up, as it is directly in the line of the incoming oriental steamers, and many hours can be saved in the passage of freight and passengers through the Atlantic seabord by transhipping there instead of going on to Vancouver and shipping over the Canadian Pacific. From this branch line across the island a road will be built down through the center of the island to Fort Rupert, passing through a rich agricultural, coal mining and timber country. On the division east from Duluth the transfer boats will carry the trains to the end of Butte Inlet, where they will be put on the rails leading to the north and east. From there to Yellowhead Pass, in the Rocky mountains of British Columbia, is a distance of 546 miles of good grades and through the Chilcotin country, pronounced one of the finest cattle-raising regions on the continent, the Cariboo and the Peace River country. At the pass connections will be made with the road now building from Winnipeg through Edmonton, on the Canadian Pacific, to the eastern slope of the pass. At Winnipeg some traffic arrangement now being made, but held secret, will accomplish the transcontinental completion. The road is to be built on singularly good terms. The British Pacific Construction Co. has been organized to do the work. Contracts to turn the line over to the railway company complete and in operation for the sole consideration of receiving the lands and subsidies. By December 1 it is expected the surveys will be completed and active construction begun.

ELECTRIC RAILWAYS.

CANANDAIGUA, N. Y.—The street railway company has stopped operation until January, in accordance with a provision of the franchise. During the winter the electric trolley system will be established and extensions built.

CLEVELAND, O.—The East Cleveland Electric Ry. has built two lines from the end of its street tracks, five miles beyond the eastern city limits, to a rich market gardening and grape growing section, and will fit up its old passenger cars for the transportation of freight, running the cars directly from the farms to the city market houses. Another line is being built through the country in the neighborhood of Berea for the same purpose, and several others are projected.

HAMMOND, IND.—A franchise has been granted to the Whiting, Hammond & East Chicago Street Ry. Co. and the Hammond Electric St. Ry. Co. for an electric railway to connect these towns; it will also extend to the new Robey race track. A Wharton 60-lb. girder rail will be used. The cars will be built by the Pullman Co., and will have McGuire trucks, each car carrying two Westinghouse 20-HP. motors. Two Ball engines of 150 HP. will be used. The line will be operated by the overhead wire system. Vice-Pres., C. E. Loss, Pullman Building, Chicago.

CHICAGO, ILL.—The Calumet Electric Street Ry. will have one of the largest electric railway systems in the world when completed. Mr. C. E. Loss, the contractor, informs us that over 40 miles of track have already been laid, and that plans are completed for continuing the construction work until the line is over 100 miles long. It connects the Calumet region on the north with Grand Crossing and the cable lines, and on the south with South Chicago, Kensington, Pullman and other points in the Calumet region. The line also runs to the World's Columbian Exposition by way of 67th st. The contractors for the entire system are C. E. Loss & Co., Pullman Building, Chicago.

LAKEPORT, CAL.—The Clear Lake & Russian River Railway & Navigation Co. has been incorporated by F. W. Gibson, R. W. Crump, M. S. Sayre, H. B. Wells and A. H. Spurr, to build an electric railway 20 miles long from Clear Lake, near Lakeport, to the San Francisco & North Pacific R. R. The capital stock is $500,000.

EVERETT, WASH.—The street railway company proposes to build an electric line.

HAMILTON, ONT.—The Hamilton, Watertown & Guelph Electric Ry. Co. proposes to build a line between these places and to carry passenger and freight traffic. The company will have a capital stock of $500,000, and $50,000 has been subscribed.

LONDON, ONT.—The London Street Railway Co. has made a proposition to change the motive power of the street railway to electricity, and to extend the present line, the work to be completed within the year from Jan. 1, 1893, and from and after Dec. 31, 1893, during the residue of its term, to pay annually to the city at the rate of $200 per mile of streets traversed by the street railway in lieu of taxes of every kind, with the right to the city, at the expiration of the term of the street railway company, to assume possession of the company, its property and effects, upon payment to it of the value thereof ascertained by arbitration, if not otherwise agreed to. The $200 a mile will include all lines of the company, old and new, about 11 miles.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Elevated Terminal Ry. Co. has been incorporated with a capital stock of $7,500,000, the leading promoters being Messrs. Underwood and

Greene, who have for some time been negotiating for the control of the Lake St. elevated railway, work on which has been recently resumed. The purpose of the line is to form a connection between the existing Chicago & South Side and the projected Lake St. and Metropolitan elevated railways, and provide a central union station for these lines. It is said to be the intention to advertise for bids and offer a prize for the handsomest and most practicable design for the structure of the loop line.

HORSE RAILWAYS.

PHILADELPHIA, PA.—The Philadelphia, Germantown & Chestnut Hill Ry. Co. has been authorized to build a branch in the 28th Ward, passing under Wissahickon Ave.

CHARLESTON, ILL.—The Charleston Street Ry. Co. has been incorporated by M. W. Hopkins, J. K. Rardin and J. W. Neal, with a capital stock of $100,000.

HIGHWAYS.

NEW YORK.—It is stated that the macadamizing of the Jericho turnpike in Queens Co. is not satisfactory, the stones being sharp and loose, so as to lame horses which are driven over them. The work had been accepted by the Board of County Supervisors.—Proposals for macadamizing the roads on the Kings Co. Farm, at Kings Park, L. I., will be received by the Board of County Supervisors until Nov. 28. James F. Carey, Super. Eng.

PENNSYLVANIA.—The Allegheny & Perrysville Plank Road Co., will macadamize Perrysville Ave. for 7 miles from the city line, at a cost of $60,000. It will be 60 ft. wide.

OHIO.—T. J. Stringer, of Portland Station, engineer for the Smithfield & Portland free turnpike, states that A. W. McDonald, the contractor, has a large force of men and teams at work and expects to have about six miles completed this autumn; the remaining six miles will not be completed before July, 1893. There will be a petition presented to the County Commissioners on Dec. 5, asking them to appoint Road Commissioners to locate and establish a free turnpike from Warrenton to Hopewell. There will also be petitions presented for the macadamizing of other roads in the near future, and the time is near at hand when all the principal roads in Jefferson County will be macadamized.

BRIDGES, TUNNELS AND CANALS.

PHILADELPHIA, PA.—The Common Councils' Committee on Surveys has recommended the appropriation of $150,000 for a bridge of the Schuylkill River, at the Falls.

WATER-WORKS.

New England.

BRATTLEBORO, VT.—It is stated that a new supply will soon be necessary, but nothing definite has been proposed.

EAST BARRE, VT.—It is reported that a company will be formed with a capital of not over $10,000.

NORWALK, CONN.—The estimated cost of new storage reservoir is $131,000.

RIDGEFIELD, CONN.—The New York Water-Works Construction Co. has applied for a franchise. It offers to build a pumping station at Round Lake, and put in 35 hydrants for a yearly rental of $30 each.

Middle.

DUANESBURGH, N. Y.—The Duanesburgh Water-Works Co. has been incorporated; $28,000; directors, J. Warren Lamb, Cooperstown; George Brooks, Russell Warren, and others.

SARANAC LAKE, N. Y.—The contract for water works and sewerage systems has been let to H. H. Rogers for $32,000.

JERSEY CITY, N. J.—The specifications for a new supply have been amended to require a maximum capacity of 50,000,000 gallons daily, to be secured by laying a second pipe line as soon as the city uses 32,000,000 gallons daily for three months. The time for receiving bids has been extended from Nov. 14 to Nov. 21.

VERONA, N. J.—It is reported that J. L. Johnson and Henry Ahlborn are building a reservoir near a spring from which they propose to supply this place with water.

ALLEGHENY, PA.—Bonds for a new supply have been voted, and surveys for the pipe line will be made at once.

JESSUP, LACKAWANNA CO., PA.—The Moosic Mountain Water Co. has been incorporated; $10,000; Treas., W. S. Diehl, Scranton.

LEBANON, PA.—It is reported that a company may be organized to introduce water from a reservoir, owned by Andrew Light. The borough owns works.

LOCK HAVEN, PA.—The Council has adopted a committee report which recommends the introduction of a supply from Queen's River.

PALO ALTO, PA.—The Council is considering the building of works.

SALTSBURG, PA.—Nov. 8 the people voted 145 to 81 for works.

SOUTH FORK, PA.—It is stated that a contract for works has been awarded to C. N. Stark, Greensburg, and that construction has been started.

TROY, PA.—It is reported that the borough will buy the Edgewood works and extend them.

WEST HAZLETON, PA.—E. F. and G. P. Kinser propose to build works to supply the village.

PERRYVILLE, MD.—It is reported that the Perryville Water Co. has let a contract for works to Baltimore parties. Pres., Jas. T. Graham; Vice-Pres., Joseph Condon; Secy. and Treas., H. A. Stump.

Southern.

BERKELEY SPRINGS, W. VA.—The Berkeley Springs Water-Works & Improvement Co. has been incorporated.

PIEDMONT, W. VA.—Engr. T. L. Patterson, Cumberland, Md., estimates that works can be built for $48,000.

CYNTHIANA, KY.—Works are again projected.

COVINGTON, KY.—The Kenton Water Co. has been incorporated to build and operate works to supply cities, etc.; $100,000, with power to increase to $200,000; V. P. Collins, John R. Coppin and M. C. Motch.

LUDLOW, KY.—The contract for pipelaying has been awarded to Dimmick & Co. for $19,352.

North Central.

CARTHAGE, O.—Bids will be received until Nov. 23 for a 16 × 10½ × 20-in. duplex pumping engine. Harry Simms, Secy. W.-Wks.

HARTWELL, O.—Nov. 8 a majority of 19 voted for works.

MILLDALE, O.—The Kenton Water Co. has made a proposition to the Town Trustees to introduce a supply from Covington, Ky.

NORWOOD, O.—Nov. 8 there were cast 389 votes for and 103 against issuing $50,000 of bonds for works.

READING, O.—It is reported as probable that the vote Nov. 8, on building works was favorable to the project.

EVANSVILLE, IND.—The item last week which appeared under Evanston, owing to an error of our correspondent, should have been under this head. It stated, in effect, that Consult. Engr. John A. Cole Chicago, had reported on the reconstruction of the works here.

CONNERSVILLE, IND.—Improvements are proposed. John A. Cole, Chicago, Consulting Engineer.

GREENVILLE, IND.—Wells for works are being sunk.

HILLSBORO, ILL.—The Prairie Heights Water Co. has been incorporated; $5,000; W. A. Finney, J. B. Dreybus and Wm. Kortkamp. The village owns works.

ROCKFORD, ILL.—It is reported that the city will build an $18,000 concrete reservoir.

WAUKEGAN, ILL.—About $200,000 will be expended in the spring for improving the works. A 20 × 120-ft. stand-pipe will be erected this fall. John A. Cole, of Chicago, is the Consulting Engineer. W. S. Shields, with Mr. Cole, will have charge of the construction.

Northwestern.

NEW LONDON, IA.—The "Sun" is discussing the building of works.

HARTINGTON, NEB.—Plans for works are being made.

Southwestern.

JONESBORO, ARK.—Works are projected.

VAN BUREN, ARK.—It is reported that a franchise has been granted to Thos. Connor, Joplin; estimated cost of works, $60,000.

SOCORRO, N. MEX.—It is reported that the water committee of the Council has been instructed to buy sufficient ground for a five-acre reservoir so that the waste water in the winter season can be saved.

NORTH DENVER, COLO.—The people have voted 57 to 29 to grant a 20-years' exclusive franchise to the Beaver Brook Water Co., practically the Denver City Water Co. There will be 12 hydrants.

Pacific.

ASTORIA, ORE.—Engr. A. L. Adams has reported on a new 4,000,000-gallon gravity supply, from Bear Creek, through a redwood conduit, about 14 miles in length. A reservoir is proposed.

LOS ANGELES, CAL.—Nov. 2 the people voted 4,980 to 1,192 for $526,000 of bonds for works to supply the hill districts of the city.

PALO ALTO, CAL.—Works are talked of, and connection may be made with the University system.

SACRAMENTO, CAL.—The Sacramento County Water Co. has been incorporated; $2,000,000, of which $1,100,000 has been subscribed; Albert Gallatin, H. P. Livermore, C. E. Livermore, and others. It is reported that the company proposes to buy the property of the Folsom Water Power Co. and that it may undertake to supply water for domestic purposes in Sacramento.

SANTA BARBARA, CAL.—A franchise has been granted L. D. Gates, but the extent of the proposed works is not stated.

VALLEJO, CAL.—The people have voted 1,065 to 397 to issue bonds for city works. The present works are owned by a company. Green Valley Falls, 14 miles distant, is proposed for a source of supply. The sum of $250,000 was voted. John Frey, Trustee.

Canada.

BUCKINGHAM, P. Q.—Bids for $40,000 5% waterworks debentures of the town are wanted until Dec. 5. G. L. Parker, Mayor.

WINDSOR, ONT.—It is reported that Engr. Willis Chipman, Toronto, has been engaged to report on the purification of the water.

CANNING N. S.—A company has been formed to build works in the spring.

ARTESIAN WELLS.

SCHENECTADY, N. Y.—S. H. Kennedy has offered to put down a test well on the following terms: If the well yields 5,000 gallons per hour he will receive $3,500; $500 will be deducted for a less, and the same sum added for a greater yield.

IRRIGATION.

NEW COMPANIES.—The Lincoln County Water Supply & Land Co., Colorado; $15,000. Selah Valley Irrigation Co., North Yakima, Wash.; $300,000. Eastern Washington Irrigation Co., Tacoma, Wash.; $100,000. Colorado Investment, Colonization & Irrigation Co., San Francisco, Cal.; $10,000,000; directors, James A. Waymire, Jas. Morton, and others. Orange Belt Land & Canal Co., Phoenix, Ariz.; $350,000; Benj. E. Lower, Robert Hunter, and others.

SEWERS.

BURLINGTON, VT.—The special committee to which was referred the question of the nuisance existing at the sewer outlet has reported in favor of a crib extension to cost about $6,000. For particulars address H. M. McIntosh, Cy. Engr.

LYNN, MASS.—The Drainage Committee has voted to construct a sewer in Nelson St., West Lynn, and will call for bids as soon as the plans are prepared. The contract for a sewer in Hood St. has been awarded to F. D. Mayo.

SOUTH HADLEY FALLS, MASS.—John J. Kirkpatrick, Holyoke, sends us the following information concerning the proposed sewer work at this place: At a special meeting of the town last July, a plan for a sewer system for what is known as the Hill and Central districts, comprising that portion of the village not heretofore provided with sewers, was submitted by E. A. Ellsworth, C. E., Holyoke. Owing to the small attendance at the meeting, no definite action was taken, save to postpone action until the regular annual meeting which will be in March. The work called for includes the reconstruction of the present trunk sewer to a depth of 10 ft. lower than the present trunk, which is about 1,000 ft. in length, and the construction of about 2½ miles of laterals. The materials to be used are brick and Akron pipe. The brick sewer is 4 ft. diameter for about 600 ft., and 36 × 48 ins. for 1,000 ft. Akron pipe in sizes from 12 to 24 ins. will be used for the remainder of the system. Estimated cost, $30,000. The work will probably be done by the town or by local parties, the town furnishing the pipe.

PROVIDENCE, R. I.—Plans are being made for the extension of the intercepting sewer in Valley and other streets and the contracts will be awarded as soon as possible. An iron pipe 60 to 70 ins. in diameter will be used for carrying the sewage across the Woonasquatucket River.

WESTERLY, R. I.—The Town Council has arranged with an engineer for surveys and plans for a sewerage system for that part of the town lying within the boundaries of school district No. 1.

SOUTHINGTON, CONN.—The Sewer Committee has been instructed to investigate the different systems of sewerage and report at another meeting.

BROOKLYN, N. Y.—The Board of Supervisors of Kings Co. will receive bids until Nov. 28 for the extension of sewers on the county farm, at Kings Park.

CARTHAGE, N.Y.—The plans for a sewerage system have been sent to the State Board of Health. It is not expected that construction will commence this autumn.

JAMESTOWN, N. Y.—The Board of Public Works has reported in favor of the sewer system referred to in our issues of July 28 and Aug. 11.

NEW YORK, N. Y.—The lowest bid for a sewer in Railroad Ave. was that of J. A. Devlin, $13,290.

RIVERHEAD, N. Y.—The Riverhead Improvement Society is considering a proposition for the drainage of this village. It is proposed to organize a stock company with a capital of about $4,000 and lay sewer pipes and drains through the principal streets.

ERIE, PA.—The proposition to issue sewer bonds for $125,000, referred to in our issue of last week, has been defeated, and the question will not come up again until the February election.

PHILADELPHIA, PA.—The Director of Public Works will receive bids until Nov. 21 for a main sewer in Germantown Ave., Garfield, Wister and Jefferson Sts.; also for branch sewers. The Director of Public Works has been authorized to construct sewers in 32 streets.

RIDLEY PARK, PA.—The Council has decided to construct sewers in all parts of the borough as soon as possible.

ROANOKE, VA.—The Board of Public Works will receive bids until Nov. 21 for several sewers, the city to furnish terra cotta and iron pipe.

JACKSONVILLE, FLA.—Surveys and estimates are being prepared for a main sewer in Bay St.

IRONTON, O.—We are informed by J. R. C. Brown, Cy. Engr., that work on the proposed sewer system, to which reference was made in our issue of Oct. 27, will not commence this year. The plans of Rudolph Hering will, however, be used as the base of future work. The city is situated in the level valley of the Ohio River, and is ⅛ to ¾ of a mile in width, by 3 to 3½ miles in length, with the water-works situated on the river one-third the distance from the lower end of the city, and with surrounding hills draining through the city into the river.

WARREN, O.—The proposed sewer along Red Run will be of 18 to 24-in. vitrified pipe, and is estimated to cost about $12,000.

NAPERVILLE, ILL.—Plans and specifications for a separate system of sewers, 12 miles in length, have been prepared by J. A. Cole, Consult. Engr., Chicago.

KANSAS CITY, MO.—The proposed joint intercepting sewer has been abandoned. The Council of Kansas City, Kan., has awarded the contract for that part of the sewer to be in the state of Kansas to L. S. Baldwin, at about $26,000. The Board of Public Works has been authorized to advertise for bids for the part to be in the state of Missouri, and $10,000 has been appropriated for the work.

MEXICO, MO.—All bids for the proposed sewer have been rejected, and the work will be done by the city under the direction of a competent engineer.

OMAHA, NEB.—The Board of Public Works will receive bids until Nov. 25 for a sewer in district No. 174.

DENVER, COLO.—A contract has been awarded to J. B. Hindry, at about $11,000.

STREETS.

BANGOR, ME.—The City Council has authorized the Street Commissioner to solicit proposals for supplying the city with 80,000 granite paving blocks for next year's work.

BOSTON, MASS.—The Board of Aldermen is considering an order for a loan of $550,000, of which $387,500 is to be used for the construction of Blue Hill Ave.

ALBANY, N. Y.—City Engineer Andrews has prepared plans for the Northern Boulevard. The proposed boulevard is to be built from Knox St., across the ravine in which the tracks of the N. Y. C. R. R. run, to connect with the Van Rensselaer Boulevard, a distance of a little over a mile.

BROOKLYN, N. Y.—The Commissioner of City Works will receive bids until Nov. 22 for resurfacing one street with asphaltum, and until Nov. 30 for grading and paving three streets with cobblestone.

NEW YORK, N. Y.—The Commissioner of Public Works will receive bids until Nov. 28 for grading, flagging, curbing, etc.

YONKERS, N. Y.—The contract for paving Warburton Ave. with sheet asphalt has been awarded to the Barber Asphalt Paving Co., at $94,060. The Warren-Scharf Asphalt Paving Co. bid $95,670, and the Sicilian Asphalt Paving Co., $97,050.

ALLEGHENY, PA.—About $600,000 of the bond issue will be used for street improvements. It is proposed to spend $200,000 a year, and to improve the main thoroughfares before the side streets are begun. The City Engineer is planning for the proposed work.

PHILADELPHIA, PA.—The Director of Public Works

has been authorized to contract for paving three streets with vitrified paving brick.

PENSACOLA, FLA.—Palafox St. is to be paved by the Birmingham Vitrified Paving Co. The work will commence Jan. 10 and is to be completed by April 15.

NEWPORT, KY.—The City Council has ordered street improvements to cost about $248,000. It is claimed that if the work is advertised at once the cost will be much less than if it is delayed till spring.

CINCINNATI, O.—The Board of Administration will receive bids until Dec. 6, 7, and 8 for plank, brick and freestone flag sidewalks, respectively.

CLEVELAND, O.—A park of 200 acres has been offered free to the city, the city to build a boulevard to it from Wade Park. The proposed park is a part of the Shaker property, which was purchased by a syndicate last June for $715,000, and is just east of the city limits and six miles in an air line from the Public Square. N. F. Barrett, Landscape Engr., New York, has been at work for some time laying out the property. Other parties have offered to donate land for several smaller parks of 25 to 40 acres each on the line of the boulevard, and the project is reported as meeting with much favor.

GOSHEN, IND.—The City Council has voted to pave Main St. and Lincoln Ave. with vitrified brick.

INDIANAPOLIS, IND.—The Board of Public Works will receive bids until Nov. 23 and 28 for grading and paving with brick.

CRESTON, IA.—The property owners have petitioned to have Pine St. paved with two courses of Galesburg paving brick.

ELECTRICAL.

DANVERS, MASS.—J. C. R. Peabody is interested in a company about to be organized with a capital of $20,000, to put in a plant for both lighting and power purposes.

NEW YORK, N. Y.—The Gas Commission will open bids Dec. 8 for street lighting for 1893. The commission has decided to use electricity instead of gas in all streets where subways have been completed, and a large number of additional lights have been ordered, including 200 arc lights in wards 23 and 24. The change from gas to electricity will increase the item for street lighting in the budget for 1893 to about $850,000.

MIDDLETOWN, PA.—Bonds have been issued for $25,000 to put in an electric light plant.

WEST NEWTON, PA.—It is reported that bids are being received for a municipal plant.

LAUREL, MD.—The City Council has accepted the bid of I. W. Kloman for lighting the streets by electricity. The proposition is for 100 incandescent lights of 32 c. p. each, at $12 per light per year, each light to burn till 1 o'clock, or $15 each for all-night lights. Additional lights will be furnished at the same rate, and the contract is for five years. The plant is to be completed within 60 days from the signing of the contract.

BARDSTOWN, KY.—The citizens are discussing the advisability of constructing a plant for street lighting.

FAYETTE, MO.—Electric light bonds for $12,000 have been sold.

MARLIN, TEX.—The Marlin Ice & Electric Light Co. is reported about to construct a plant.

SALT LAKE CITY, UTAH.—C. F. Annett and W. G. Van Horne have petitioned the City Council for a franchise to erect a plant for lighting and power purposes. They offer to furnish free to the city, during the continuance of the franchise, 50 incandescent lights of 16 c. p. each, and one arc light of 2,000 c. p.

EVERETT, WASH.—The Everett Land Co. has decided to erect an electric light plant, construction to commence at once.

PORT HOPE, ONT.—The Town Council has voted to ascertain the cost of an electric light plant.

NEW COMPANIES.—Kennedy Electric Co., Chicago, Ill.; $100,000; H. R. Powers, Snyder Evans, Frederick Arnd. Crowdus Electric Light Co., Milwaukee, Wis.; $75,000; W. W. Bromley, W. F. Miller, Thos. K. Ewing.

CONTRACT PRICES.

SEWERS.—Fort Wayne, Ind.—F. M. Randall, Cy. Engr., has sent us a statement of the bids received for about 2.3 miles of 4 to 6-ft. brick sewer. The bidders and the total bids were as follows: 1, F. E. Cole, Toledo, O., $81,330; 2, Gantz & Sullivan, Columbus, O., $86,073; 3, Wilding & Derheimer, Fort Wayne, Ind., $88,943; 4, J. C. Murry, Newark, O., $96,813; 5, W. J. Gawue, Cleveland, O., $102,875; 6, McMullen & Morris, St. Paul, Minn., $109,904; 7, Wilson & Strack, Cincinnati, O., $124,583. The prices are given per foot, except for catch basins, and are in this order: A, 3,940 lin. ft., average cut 22 ft. 6 ins.; B, 3,800 lin. ft., average cut 26 ft.; C, 4,500 lin. ft., average cut 17 ft. 4 ins.; D, 900 lin. ft., 12-in. connections; E, 794 vert. ft., manholes; F, 45 catch basins.

	A.	B.	C.	D.	E.	F.
1	$7.96	$6.10	$5.15	$.75	$2.00	$30.00
2	7.70	7.00	5.40	.45	3.87*	36.50
3	8.30	7.28	5.40	.75	3.12	25.00
4	9.70	7.40	5.90	.60	2.45	32.00
5	9.85	8.20	6.20	1.80	4.00	40.00
6	10.07	9.75	6.37	1.25	2.00	40.00
7	11.80	10.80	7.00	1.30	3.25	40.00

* $3.87, 3.40, 3.15.

Boston, Mass.—The Metropolitan Sewerage Commission opened bids Nov. 5 for a part of section 27 of the main sewer, between Cambridge and Somerville. The sewer will be 2,750 ft. in length, have an average cut of 25 ft., a maximum diameter of 6.3 ft., and will require 1,870 cu. yds. of masonry. The bids were as follows:

National Construction Co., Boston, A. earth excavation and refill, 2,750 lin. ft., $12.70 per lin. ft.; B, brick masonry, Am., 850 cu. yds., $13 per cu. yd.; C, brick masonry, Port., 250 cu. yds., $14.50; D, concrete masonry, Am., 600 cu. yds., $5; E, concrete masonry, Port., 70 cu. yds., $7; F, rubble stone masonry, Am., 100 cu. yds., $6; G, spruce lumber in place, 10,000 ft. B. M., $35; H, spruce piles, driven, 1,000 lin. ft., 20 cts.; T, total, $54,240.

Christopher McBride, Brighton, A, $12; B, $13.50; C, $15; D, $6; E, $7; F, $6; G, $40; H, 25 cts.; T, $53,565.

John Sheehan, Lynn, A, $9.50; B, $12.90; C, $15; D, $6; E, $7; F, $7; G, $35; H, 25 cts.; T, $46,230.

Jones & Meehan, Jamaica Plain, A, $10; B, $12; C, $14; D, $5; E, $8; F, $3; G, $35; H, 20 cts.; T, $45,619.

Everson & Liddle, Providence, R. I., A, $10; B, $12; C, $14; D, $5; E, $6; F, $4; G, $35; H, 5 cts.; T, $45,420.

H. P. Nawn, Roxbury, A, $9; B, $12.50; C, $14; D, $5; E, $6; F, $3; G, $30; H, 15 cts.; T, $43,045.

Metropolitan Construction Co., Boston, A, $7.65; B, $11.85; C, $13.53; D, $5; E, $6.68; F, $1; G, $35; H, 15 cts.; T, $38,560.

STREET WORK.—Albany, N. Y.—The contract for repaving Maiden Lane from Broadway to Quay St. has been awarded to Jacob Holler, at the following prices: Paving with granite, $4.55 per sq. yd.; curb, $1.45 per lin. ft.; circular curb, $1.55 per ft.; crosswalk, 48 cts. per ft.; repaving of granite, 70 cts. per sq. yd.; manhole, $15; credit for cobble, 1 ct. per yd.; credit for curb, 1 ct. per ft.

Boone, Ia.—The City Council has awarded the contract for paving several streets with brick to E. G. Culver, Boone, at $1.64 per sq. yd. for paving, and 38 cts. per lin. ft. for curbing. The work will not commence until March 15 and is to be completed by Oct. 15 next.

Kansas City, Mo.—Contracts have been awarded as follows: Geo. J. Baer, paving with granite, $3.36 per sq. yd.; paving with vitrified brick, $1.75 to $1.93. C. L. Powell, paving with vitrified brick, $1.97. W. H. Crowley, macadamizing, 74 cts.

Quincy, Ill.—Bids were opened Nov. 3 for paving Main St. and Broadway with brick. The lowest bid for Main St. aggregates about $44,000, and that for Broadway, $8,600. The bids were as follows, where two prices are given the first being the bid for Main St.: T. J. Shea, A, paving, $1.80 per sq. yd.; B, new curb, limestone, 60 cts. per lin. ft.; C, new curb, sandstone, 50 cts. Simmons & Boyd, A, $1.84, $1.82; B, 55 cts.; C, 50 cts.; D, resetting old curb, 10 cts. Nils Pierce & Co., A, $1.83; B, 60 cts.; C, 50 cts.. F. W. Menke & Co., A, $1.80, $1.85; B, 60 cts.; C, 53 cts.; D, 10 cts.

CULVERT.—Oakland, Cal.—The Town Trustees have awarded to W. J. Schmidt the contract for a concrete culvert where Strawberry Creek crosses Shattuck Ave. The avenue is 160 ft. wide at this place, and the price for the work is as follows: Cement work, $17.50 per cu. yd.; brick work, $21 per M.; excavation, 41 cts. per cu. yd.; ironstone culvert, $2.50 per ft.; catch basin, $75. The cost is estimated at $7,000.

MISCELLANEOUS.

CITY HALL.—Milwaukee, Miss.—The Board of Public Works will receive bids until Nov. 25 for furnishing all the material and doing the work required to construct a city hall in accordance with plans now on file.

SINKING SHAFT.—Kansas City, Mo.—The North Kansas City Coal Mining Co. will receive bids until Nov. 25 for sinking an escapement shaft, 5 × 7 ft., to a depth of about 435 ft., at Randolph, Clay Co., Mo.

STREET CLEANING.—Cleveland, O.—The Director of Public Works will receive bids until Dec. 7 for cleaning the paved streets of the city for one year ending Dec. 31, 1893. The city will be divided into three street cleaning districts, and bids are asked per mile for each time cleaned.

REPAIR OF JAIL.—Mariposa, Cal.—The Board of Supervisors will receive bids until Jan. 5 for the repair of the Mariposa Co. jail. Bids will be received for placing a metallic roof upon the walls at the bottom of the present windows, and finishing a safe and comfortable room under the roof suitable for keeping persons under detention, all the inside work to be of fireproof material. Bids will also be received for rebuilding the former structure in stone, all the inside work to be of fireproof material, with a metallic roof, in each case the bid may also be for a roof covered by shakes or shingles.

BRICK WALLS.—New York, N. Y.—The Department of Parks will receive bids until Nov. 23 for taking down and rebuilding the brick walls of the annex in the Castle Garden building, in Battery Park.

GAS COMPANY.—Chicago, Ill.—The Cicero Illuminating & Natural Gas Co., has been incorporated by F. R. Babcock, R. C. Young and J. E. Ford; capital stock, $1,000,000.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have orders for 25 simple and 25 four-cylinder compound engines, for the Philadelphia & Reading, 45 consolidation freight engines for the Pennsylvania, 35 passenger and freight engines for the Central of Brazil, 2 four-cylinder compound consolidation engines for the Norfolk & Southern, a four-cylinder compound for the Marietta & North Georgia, and a ten-wheel passenger engine for the Richmond & Danville; the three simple Abt rack engines of the Manitou & Pike's Peak rack railway, are being compounded, on account of the success of the first compound for that road; the works have built 10 four-cylinder consolidation engines for the Lehigh Valley. The Rhode Island Locomotive Works, Providence, R. I., have built 5 passenger engines for the Wabash. The Baltimore & Ohio will place orders for 15 passenger and 35 freight engines. The Pennsylvania will build at its shops at Fort Wayne, Ind., 14 class X passenger engines for the World's Columbian Exposition traffic; this is the company's heaviest type of passenger engine.

CARS.—The Indiana Car Co., Indianapolis, Ind., has an order from the Illinois Central for 100 of the special cars for the World's Columbian Exposition, which are described and illustrated in another column, and is building 200 stock cars for the Hicks Car Co. The Lebanon Mfg. Co., Lebanon, Pa., has recently delivered freight cars to the Huntington & Broad Top and Wilmington & Northern. The Ohio Falls Car Co., Clarksville, Ind., is building 300 freight cars for the Nashville, Chattanooga & St. Louis. The United States Car Co. has leased the works of the United States Rolling Stock Co., at Hegewisch, Ill.; Urbana, O.; Anniston, Ala., and New Decatur, Ala. Gen. Man., G. W. Ristine, Chicago. The St. Louis Car Co., Laclede Car Co., Brownell Car Co., and American Car Co., all of St. Louis, Mo., may be consolidated as one company.

LOCOMOTIVE AND CAR WORKS.—The New York Locomotive Works, Rome, N. Y., were sold Oct. 27, and bid in by Ralph N. Ellis and William B. Isham, of New York, and Thomas H. Stryker, of Rome, representing the first consolidated mortgage bondholders, for $197,074, subject to the first mortgage of $150,000, and interest from Aug. 1, 1891. The plant will probably be put in operation soon, but not as a locomotive works.—The Great Northern Ry. will establish works at Seattle, Wash., for building and repairing engines and cars.

RAILS.—The South Florida R. R. is replacing its 50-lb. rails with 70-lb. rails.

STEEL FOUNDRY.—The Congdon Brake Shoe Co., of Chicago, has completed an extensive steel casting plant at 59th and Wallace Sts., Chicago, containing many interesting features, and forming a good example of recent practice in foundry construction. The buildings are of brick with iron frames, well ventilated and lit by skylights, and a clear-story extending the whole length. Several systems of power distribution are in use. The foundry has a line shaft connected to the engine; the steel foundry receives power from the main engine by manilla rope transmission; the plant in the machine and pattern shops and other outlying portions of the works, is driven by electric motors, taking current from two 35-HP. dynamos, driven by a 100-HP. Russell engine. There are two Rice & Whitacre boilers, burning Lima oil. The Hunt system of tramways, described in our issue of June 16, 1892, has been adopted; and the works are also served by hand jib cranes and a Shaw electric jib crane of large capacity. The open-hearth and crucible furnaces, gas producers, and core and annealing ovens, were built by J. O. Herricks, of Philadelphia.

ROAD ROLLERS.—Two of the Pope reversible, subgrade rollers, 5 and 7 tons, have been ordered by the City Engineer of Louisville, Ky. The city of Chicago uses seven of these rollers, and ten others are being built for that city. By order of Mr. Dorr, Engineer of the Street Department, the horse roller is to be used for all sub-grade work in Chicago.

THE KING BRIDGE CO., Cleveland, O., is furnishing three signal bridges for use by the Union Switch & Signal Co., at the Stewart Ave. crossing, Chicago (Eng. News, Sept. 22); also 7 for the Chicago & Northwestern Ry. signal plant, at Chicago, and 27 for the Pennsylvania R. R., at Philadelphia.

THE PASSAIC ART CASTING CO., of Passaic, N. J., and 35 Warren St., New York, is doing some remarkably fine work in fine castings in bronze, brass, aluminum and German silver. We have seen reproductions of repousse, chased and undercut work that so closely imitate the fineness of line and sharpness of detail of the best hand work as almost to defy detection. This company makes a specialty of machinery, name plates, aluminum bronze dies and molds for stamping softer metals and small gearing for optical and surgical instruments.

THE RAND DRILL CO. has opened an office in the Monadnock Building, Chicago. James F. Lewis, is in charge.

THE KENWOOD BRIDGE CO., of Chicago, is getting out some 46-ft. plate girders for the Blue Island Ave. viaduct, Chicago, and some extra heavy Z-bar columns for the new Y. M. C. A. building, Chicago. A new large size Williams, White & Co.'s bulldozer and a new angle bar shearing machine have recently been added to the plant. Pres., F. W. Barker; Secy., Paul Willis.

C. E. LOSS & CO., Chicago, general contractors, have removed their offices to the Pullman Building. Mr. Loss has large forces at present working on the Calumet Electric St. Ry. Co., of which over 30 miles have already been laid. When completed, this line will be over 100 miles long. Work is also soon to be commenced by this company on a new electric line to connect Whitings, East Chicago and Hammond, Ind.

W. S. REED & CO., contractors for water-works, electric light plants, sewers, etc., have removed their offices to the Rookery Building, Chicago. They have increased the capital stock and intend to build water-works, etc., in all parts of the U. S. on the franchise plan. Mr. Reed was formerly connected with Moffett, Hodgkins & Clarke, of New York.

NEW COMPANIES.—Galveston Harbor & Deep Water Construction Co., and Bolivar Navigation Co.; Galveston, Tex.; $3,000,000; Jos. Laing, E. K. Smoot, John F. O'Connor, and W. L. Crawford, all of Dallas, Tex. Fitch Excelsior Switch Co., Jersey City, N. J.; $200,000; C. M. Fitch, South Norwalk, Conn.; Lindley Murray, Brooklyn, N. Y., and John B. Conklin, Catskill, N. Y. Swansea Steel & Tin Plate Co., Chicago, Ill.; $200,000; Walter R. Howard, L. L. Shirley and J. E. Roberts.

CURRENT PRICES.

RAILS.—New York: $30 at eastern mills, $30.75 at tidewater; old rails, $17 for iron, and $14.50 to $15 for steel. Pittsburg: $30; old rails, $20.50 to $20.75 for iron and $15.50 to $15.75 for steel. The "Iron Age" states that it is rumored that the price of rails is to be reduced to $28. Chicago: $30 to $32.50; light rails, $32; old rails, $18.75 to $19 for iron, and $13 to $14.50 for steel.

TRACK MATERIAL.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron and steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.7 to 1.75 cts. for iron and steel; spikes, 2.05 to 2.1 cts. at mill; track bolts, 2.05 to 2.75 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 57½ and 10% and 50% and 10% on black and galvanized butt welded; 67½% and 10%, and 60% and 10% on black and galvanized lap welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $13.50 to $15.50. Pittsburg: $13 to $14.25. Chicago: $13.25 to $14.25.

LEAD.—New York: 3.85 to 3.9 cts.; Chicago: 3.72 to 3.75 cts.; St. Louis: 3.67 to 3.7 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.35 to 2.75 cts. for small lots; channels, 2.25 to 2.5 cts.; angles, 1.95 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates, 1.9 to 2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2.05 to 2.2 cts.; channels, 2.05 to 2.2 cts.; angles, 1.85 to 2 cts.; tees, 2.4 to 2.5 cts.; Z-bars, 2 to 2.05 cts.; universal mill plates, 1.75 to 1.85 cts. for steel; sheared steel bridge plates, 2.1 to 2.25 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.75 to 2 cts. for tank, 2 to 2.25 cts. for shell, 2.1 to 2.35 cts. for flange, 3.5 to 3.75 cts. for firebox, 2.1 to 2.25 for bridge. Chicago: beams, 2.27 to 2.35 cts. for large lots, and 2.45 to 2.75 cts. for small lots; channels, 2.27 to 2.35 cts. for large lots, and 2.45 to 2.75 cts. for small lots; angles, 1.9 to 2 cts. for large lots, and 2 to 2.35 cts. for small lots; tees, 2.2 to 2.3 cts.; universal plates, 2.05 to 2.15 cts.; steel plates, 2.1 to 2.15 cts. for tank, 2.17 to 2.25 cts. for shell, 2.3 to 3.4 cts. for flange, 2.7 to 2.8 cts. for firebox.